An Introduction to California's Ocean Observing Systems

How to use ocean observing system data related to water quality assessment

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CeNCOOS

Sept. 24, 2012

Southern California Coastal Ocean Observing System

Introduction Outline

- What is U.S. IOOS®?
- What are CeNCOOS and SCCOOS?
- How are we funded?
- What do we do?
- How does it apply to water quality in California?
- What's in store for the future?

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What is U.S. IOOS?

- US contribution to Global Ocean Observing System
- Program Office in D.C. within NOS / NOAA
- Includes global (satellites, drifters, etc.) and coastal components
- Coastal component includes 17 Federal agencies, 11 regional associations and 2 other consortia
- Federal backbone of coastal component includes tide gauges, NDBC buoys, etc.

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Purpose of U.S. IOOS

A tool that enables the Nation to track, predict, manage and adapt to changes in our ocean, coastal and Great Lakes environment for the purposes of:

Improving safety **Enhancing our economy** **Protecting our environment**

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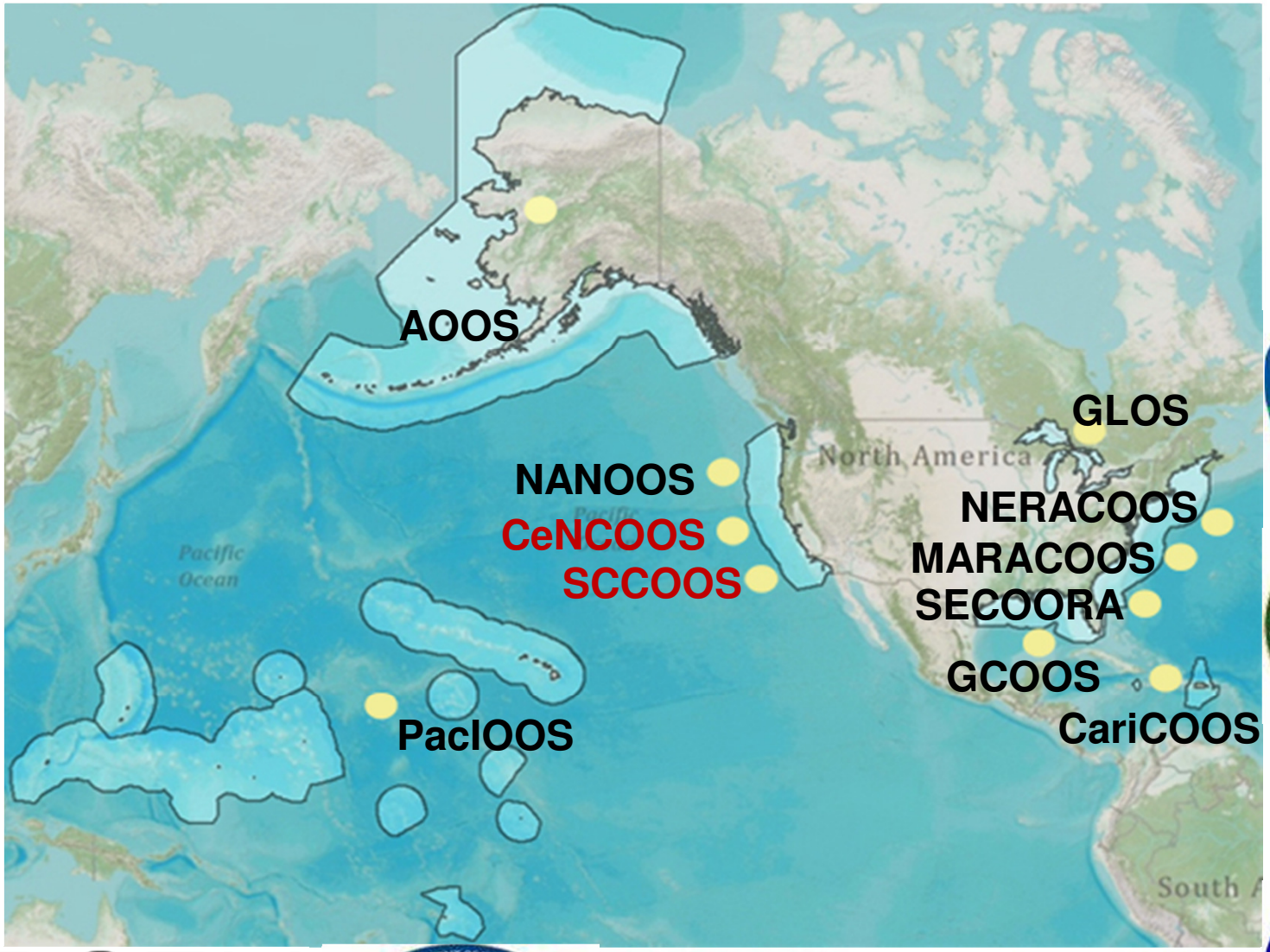
IOOS Coastal Component

11 Regional Associations; 17 Federal Agencies



BOEM Bureau of Ocean Energy Management

USGS

US Army Corps of Engineers

FDA

What are CeNCOOS and SCCOOS?

- CeNCOOS www.CeNCOOS.org
  - Central and Northern California Ocean Observing System
  - Extends from Pt Conception to OR border
  - Program Office at MBARI, Moss Landing
  - 48 member organizations
- SCCOOS www.SCCOOS.org
  - Southern California Coastal Ocean Observing System
  - Extends from Pt Conception to Mexican border
  - Program Office at Scripps Inst. of Oceanography, San Diego
  - 11 member organizations

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What are CeNCOOS and SCCOOS?

- They support Principal Investigators at institutions throughout the state who operate the observing system
- They each have a governing body
  - CeNCOOS: 15 member elected Governing Council
  - SCCOOS: 10 member Board of Governors
- They share a 33-member Joint Strategic Advisory Committee linking them with broad stakeholder interests and knowledge within California

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CeNCOOS and SCCOOS Program Office Staffs

- **CeNCOOS**
  - Director: Leslie Rosenfeld (60% time, started 9/11)
  - Program Manager: Janine Scianna (90%, 1/12)
  - Information Manager: Jennifer Patterson (90%, 4/12)
  - Product Developer: Fred Bahr (50%, 10/08)
- **SCCOOS**
  - Director: Julie Thomas (25%, 1/08)
  - Program Coordinator: Danielle Williams (100%, 5/12)
  - Data & Information Manager: Lisa Hazard (30%, 2/05)
  - Public & Government Relations Coordinator: Chris Cohen (40%, 2/10)
  - Technical Director: Eric Terrill (10%, 2/05)

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How are CeNCOOS and SCCOOS funded?

- Primary funding is via 5-year grant from NOAA IOOS
  - Year 1 (6/11-5/12): ~$1.75M to each of SCCOOS and CeNCOOS
  - Year 2 (6/12-5/13): ~$2.1M to each of SCCOOS and CeNCOOS
  - Year 3 (6/13-7/14): ????????
- Other smaller current and anticipated funding sources include:
  - NOAA HABs (CeNCOOS and SCCOOS)
  - OCSD (SCCOOS; CeNCOOS in future)
  - Deepwater Desal (CeNCOOS)
  - ASBS (SCCOOS)
  - CA Dept. of Boating & Waterways (SCCOOS Manual Shore Program)
- In the past, significant funding came from:
  - California State Coastal Conservancy

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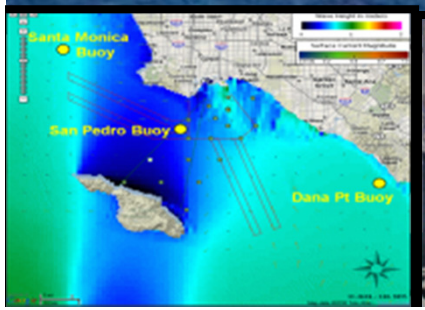
What do CeNCOOS and SCCOOS do?

Manage an "end-to-end" coastal ocean observing system …

- data collection
- data management
- data dissemination
- numerical model simulations and forecasts
- product development
- user outreach and facilitation

… to benefit USERS in four broad focus areas:

- Water quality
- Ecosystems and climate
- Marine operations
- Coastal hazards






What do CeNCOOS and SCCOOS do?

The foundation is a network of ocean observing **assets** that measure:

- Physical and chemical properties (e.g. temperature, salinity, dissolved oxygen)
- Biological properties (e.g. Harmful Algal Blooms, chlorophyll fluorescence)
- Waves
- Meteorological conditions
- Surface currents

Observational assets include:

- Shore stations
- Gliders
- Moored buoys
- Land-based high frequency radar stations
- Ship-based surveys

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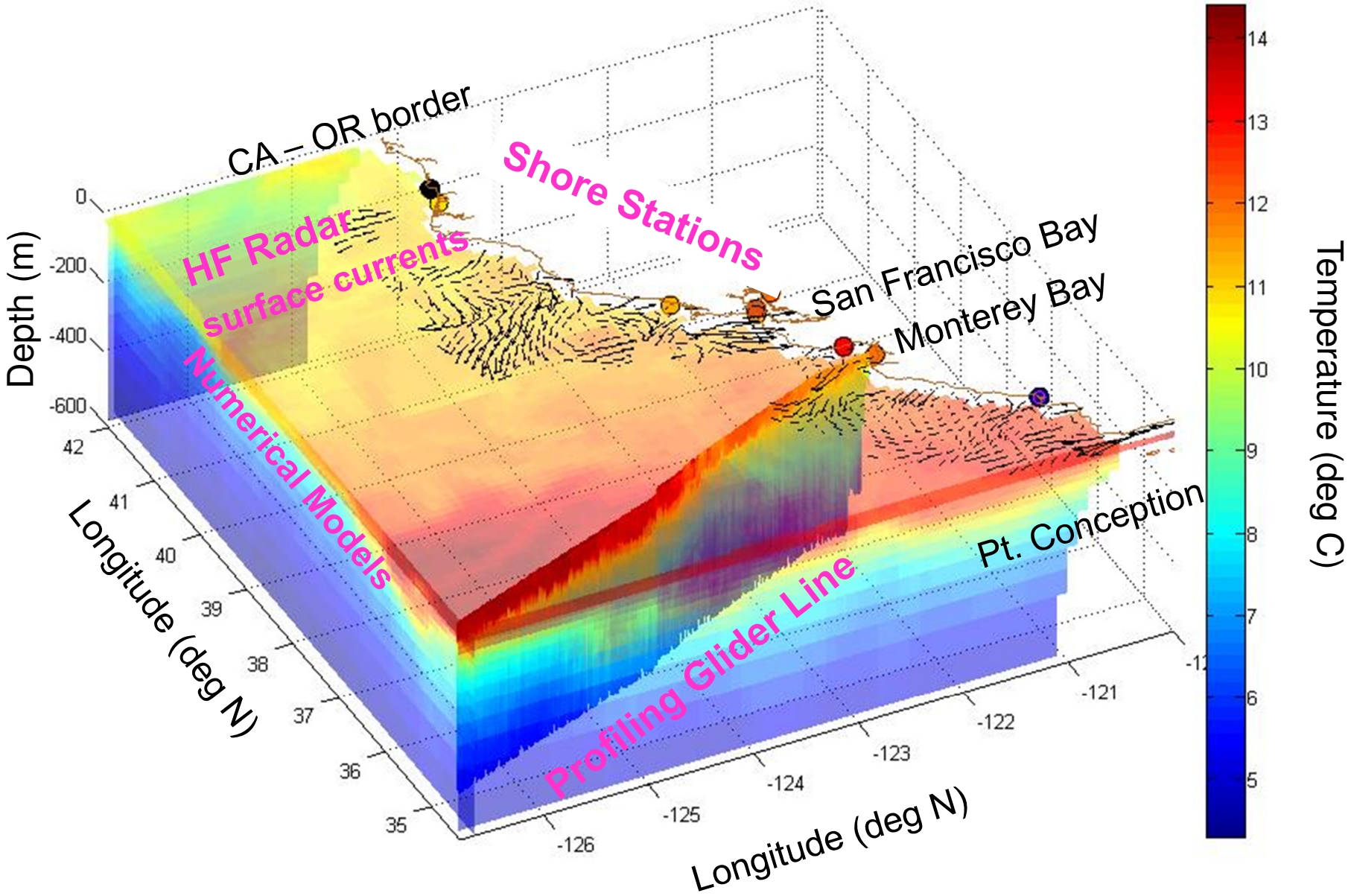
The result is an integrated picture of the ocean environment that is useful for a multitude of purposes

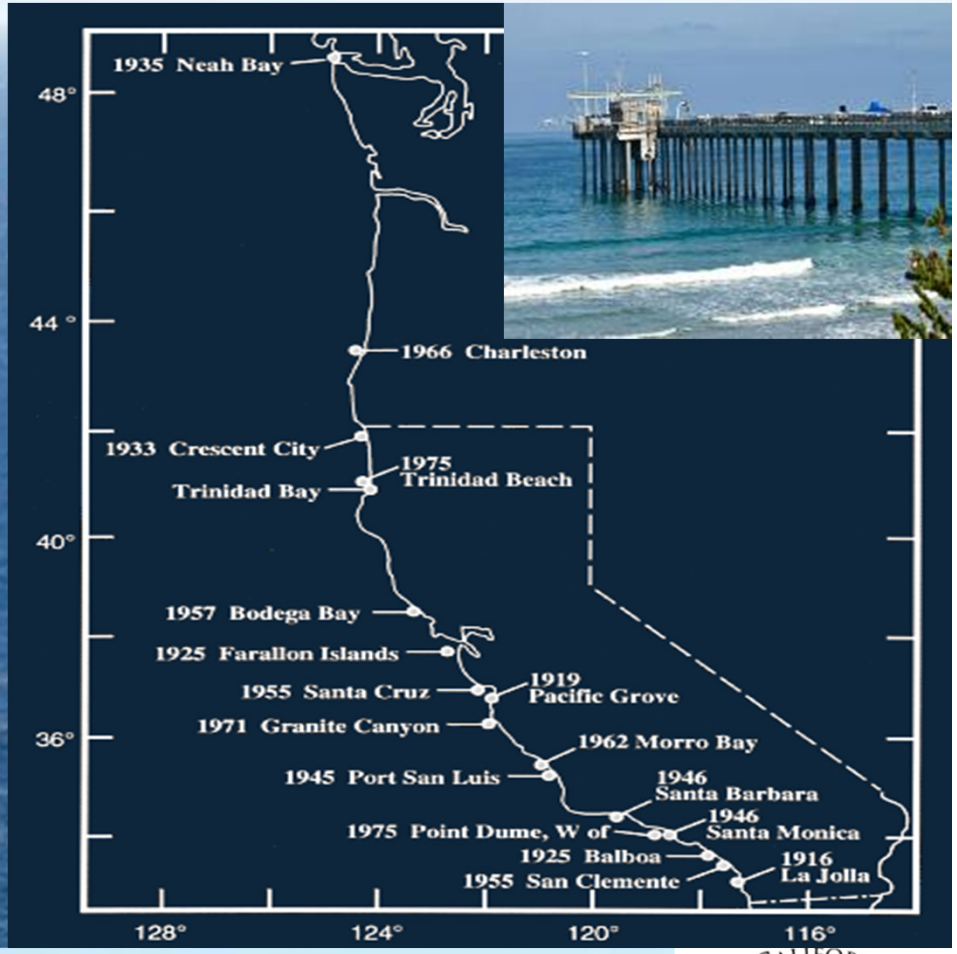


Data are from the Jan-Feb 2012 timeframe

Nearshore measurements from automated and manual shore stations

Data collected include:

- Temperature & salinity
- Chlorophyll fluorescence & turbidity or transmissivity
- Dissolved oxygen, pH, & water level
- Meteorological variables
- Phytoplankton & algal toxins to detect Harmful Algal Blooms



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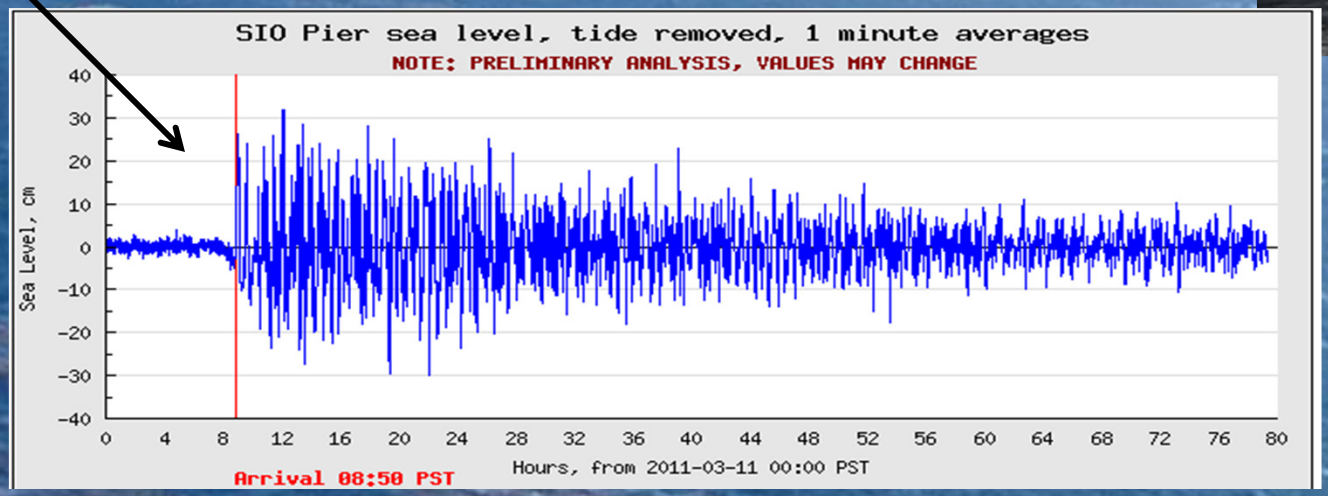
More CeNCOOS & SCCOOS Nearshore Measurements

Water density used to calculate vessel loads →

Short-term event detection; e.g. tsunamis



http://www.sccoos.org/projects/2011_tsunami/

Long-term climate records

Sea Level collected since 1855 Sea Surface Temperature collected since 1880

Ocean pH and pCO2 trends since 1993 Wave Height Trends since 1950

Coastal Upwelling trends since 1960 Salinity since 1916

CeNCOOS Shore Station

http://www.cencoos.org/sections/conditions/shore_stations.shtml

Home | About Us | News & Events | Current Conditions | Data Products | Download Data | Classroom | Models

CURRENT CONDITIONS

- Weather
- Surface Currents
- Waves
- Ocean Buoys
- Ocean Shore Stations
- Tides
- Water Quality
- Satellites
- Algal Blooms
- Web Cams

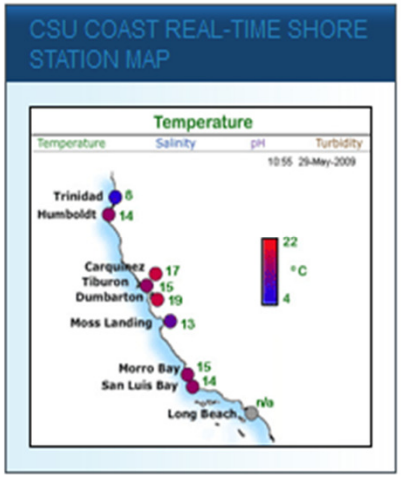
Find us on Facebook

Search Our Site

Real-time Ocean Shore Stations

View and download real-time data collected at shore stations with the CeNCOOS Data Portal or through the individual pages listed below

- Trinidad (Back Online!)
- Humboldt Bay
- Tiburon ← Click here on the Tiburon shore station
- Carquinez
- Moss Landing (Seawater Intake Station)
- Moss Landing Harbor (Removed Oct 2010)
- Monterey Wharf
- Morro Bay
- San Luis Bay
- Bodega (Horseshoe Cove)
- Fort Point (near Golden Gate Br.)
- Santa Cruz Wharf



CeNCOOS contributes funding to the operations of the stations listed above, run in coordination with our partner institutions. The stations are usually attached to piers or docks that extend no more than 100 meters from shorelines. These stations typically monitor water temperature, salinity, dissolved oxygen, pH, chloropyll and turbidity.

Other Stations

- NOAA CO-OPS Program - San Francisco PORTS program (weather, water temperature, water currents)
- NOAA National Estuarine Research Reserve Program (weather, water temperature, salinity, dissolved O2)
- Scripps Shore Station Program (datasets ranging from years to decades)
  - Active Stations (including Big Sur, Pacific Grove, Farallon Islands, Trinidad)
  - Historic Stations

CeNCOOS Shore Station Tiburon

http://sfbeams.sfsu.edu/

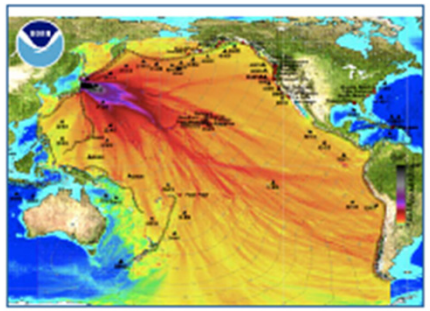
SAN FRANCISCO BAY ENVIRONMENTAL ASSESSMENT AND MONITORING STATION

SAN FRANCISCO STATE UNIVERSITY ROMBERG TIBURON CENTER

About SFBEAMS | Download Data | View Recent Data | System Specifications | Contact Us

Tsunami Felt in San Francisco Bay

Sensors in San Francisco Bay document the rapid variations in water level at various locations in the Bay.



Up-To-Date Environmental Measurements of San Francisco Bay

| Web Camera | Data Use Policies | Location Close Up | Location on SF Bay |

Current Conditions

WEATHER	RTC PIER
Local Date	Tuesday, September 04, 2012
Local Time	1:00:00 PM
UTC Date	04 Sep 2012
UTC Time	20:00 :00 GMT
Air Temp	15° C (59° F)
Rel. Humidity	79 %
Atm. Pressure	1016 mb
Wind	NW at 13mph
Rain	0 mm
PAR (Sunlight)	1473 $\mu mol\ s^{-1} m^{-2}$

WATER	RTC PIER	CARQUINEZ
Local Date	Friday, August 31, 2012	Tuesday, September 04, 2012
Local Time	7:43:00 AM	1:06:00 PM
UTC Date	31 Aug 2012	04 Sep 2012
UTC Time	14:43 :00 GMT	20:06 :00 GMT
Depth	1.2 m	2.7 m
Water Temp	18° C (64° F)	20° C (67° F)
Salinity	29 PSS	19 PSS
Density	1021 kg m^{-3} 1020 oz ft^{-3}	1012 kg m^{-3} 1011 oz ft^{-3}
Chlorophyll	2.5 mg m^{-3}	n/a
Turbidity	23 NTU	12 NTU
pH	7.91	8.46

Located north of the Tiburon Peninsula at 37° 53' 20" N • 122° 26' 48" W

SCCOOS
Automated Shore Station Page

http://www.sccoos.org/data/autoshorestations/

Available Products
Automated Shore Stations
Overview
Stearns Wharf
Santa Monica Pier
Newport Pier
Scripps Pier

Bathymetry
CA ASBS System
Gliders
Harbors
Harmful Algae & Red Tides
Manual Shore Stations
Meteorological Observations
Moorings
Plume Tracking
ROMS Model Output
Satellite Imagery
Ship Tracking (AIS)
Ship Casts
Surface Current Mapping
Wave Conditions (CDIP)
Winds & Rainfall Forecasts

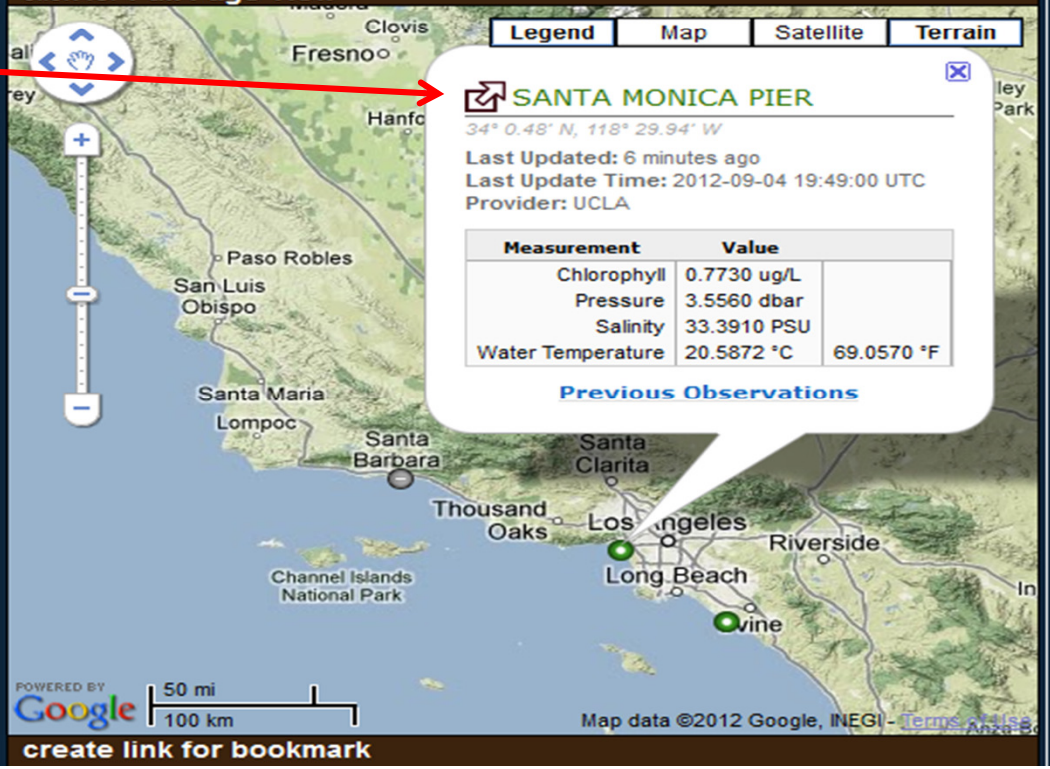
Available Services
Grab Raw Data
Advanced Mapping Applications
KML Feeds
HFRADAR THREDDS Server
SCCOOS THREDDS Server

SCCOOS AUTOMATED SHORE STATIONS

← back to Data Products

Automated shore stations consist of a suite of sensors that are attached to piers at several locations along the California coast. These automated sensors measure temperature, salinity, chlorophyll, turbidity and water level at frequent intervals in the nearshore coastal ocean. This data can provide local and regional information on mixing and upwelling, land run-off, and algal blooms.
Metadata for the stations is available here.

click for **Full Page View**



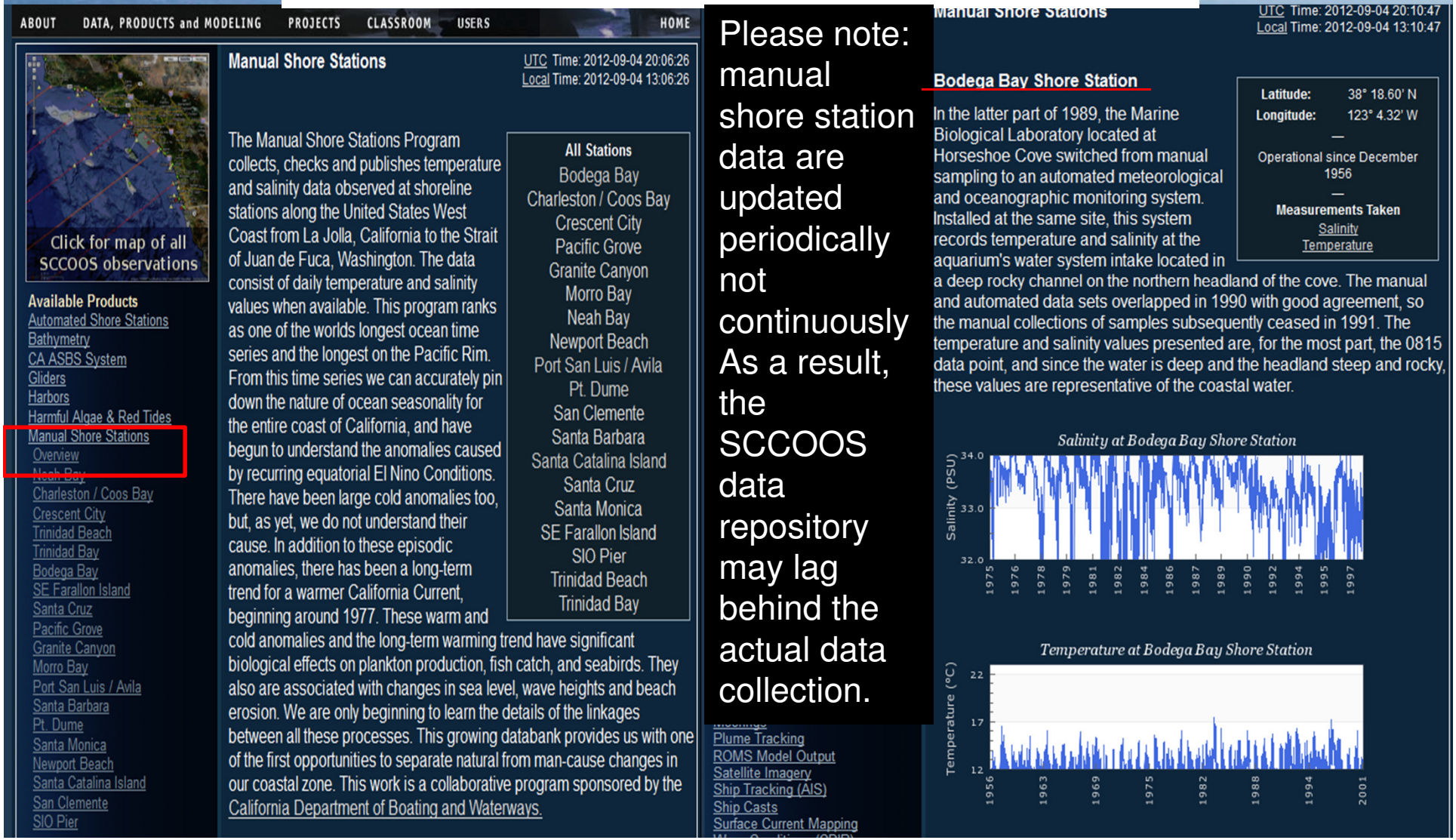
create link for bookmark

LEGEND
- Operational
- More than 3 hours old
- More than 1 day old
- More than 1 week old
- Status unknown

SITES
Stearns Wharf
> Santa Monica Pier <
Newport Pier
Scripps Pier

SCCOOS Manual Shore Station Page

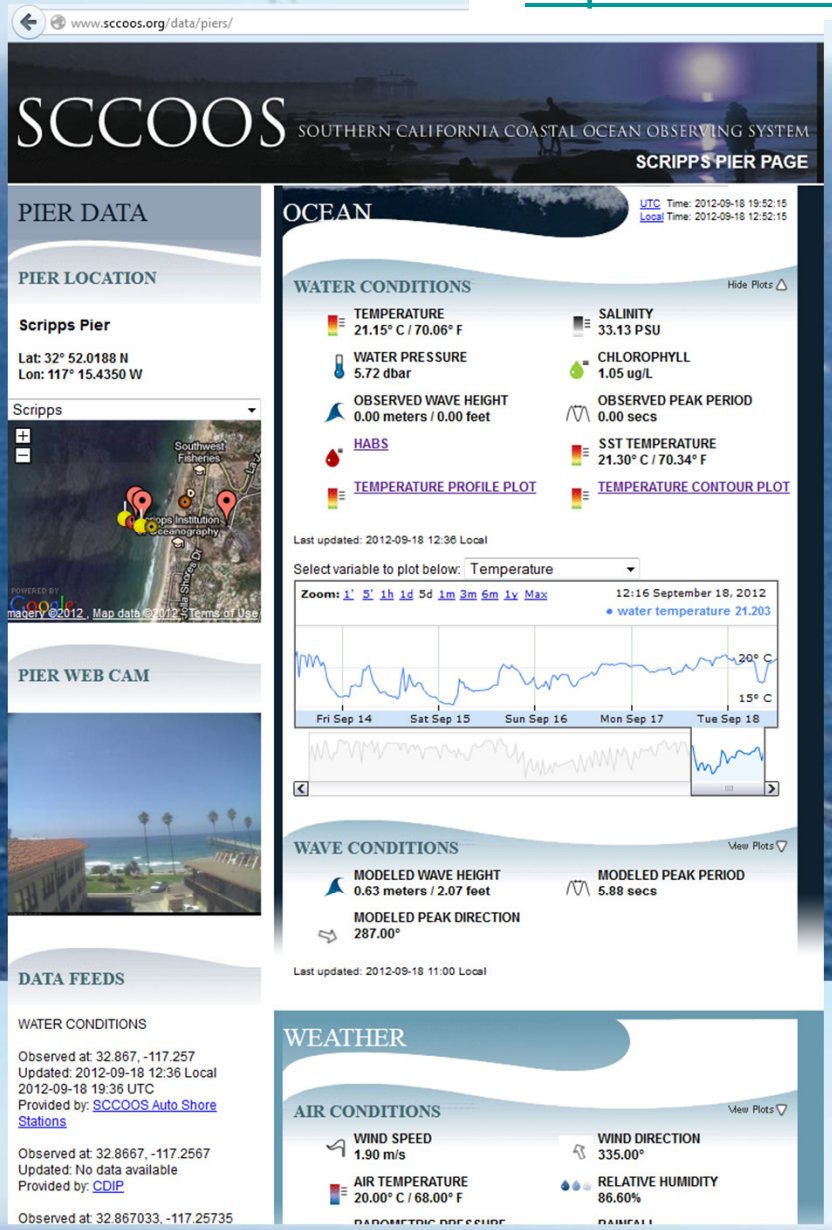
http://www.sccoos.org/data/manualshorestations/

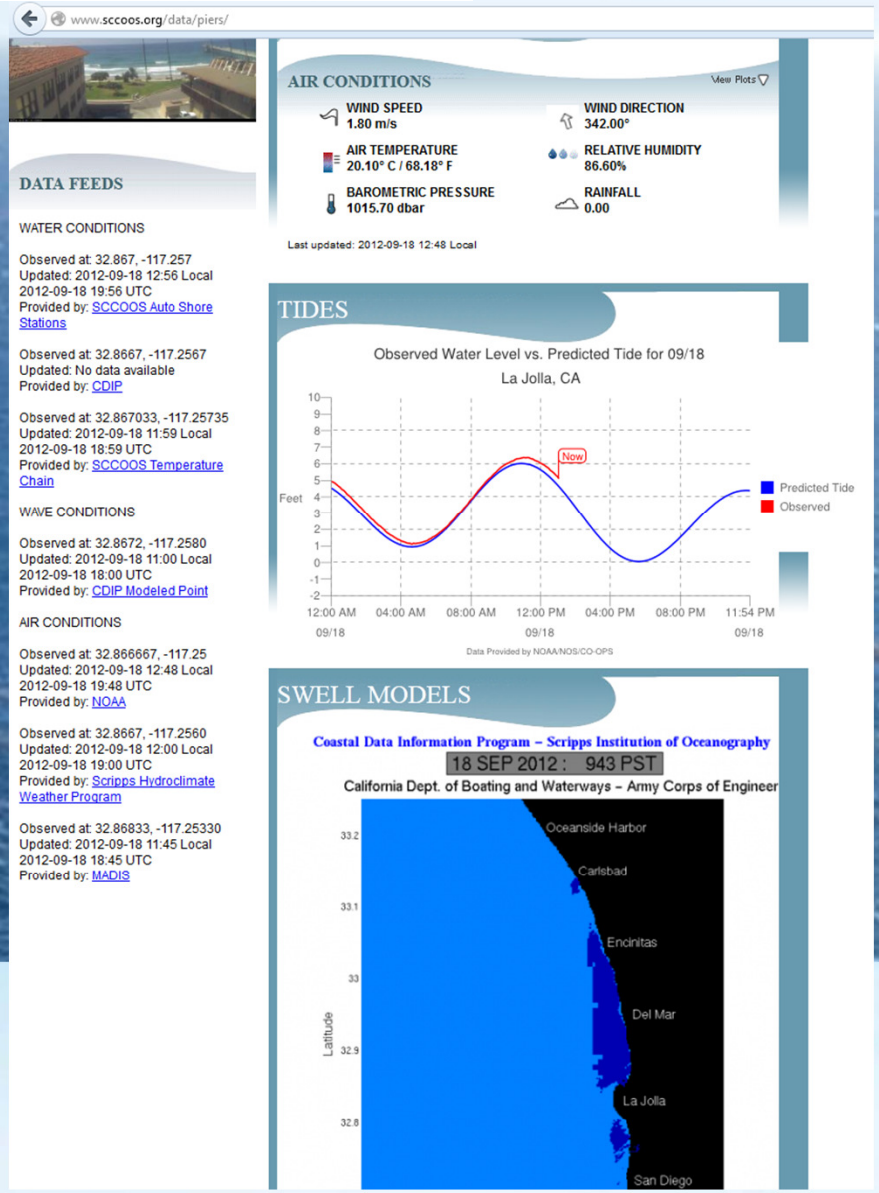


Please note: manual shore station data are updated periodically not continuously As a result, the SCCOOS data repository may lag behind the actual data collection.

SCCOOS Pier Pages

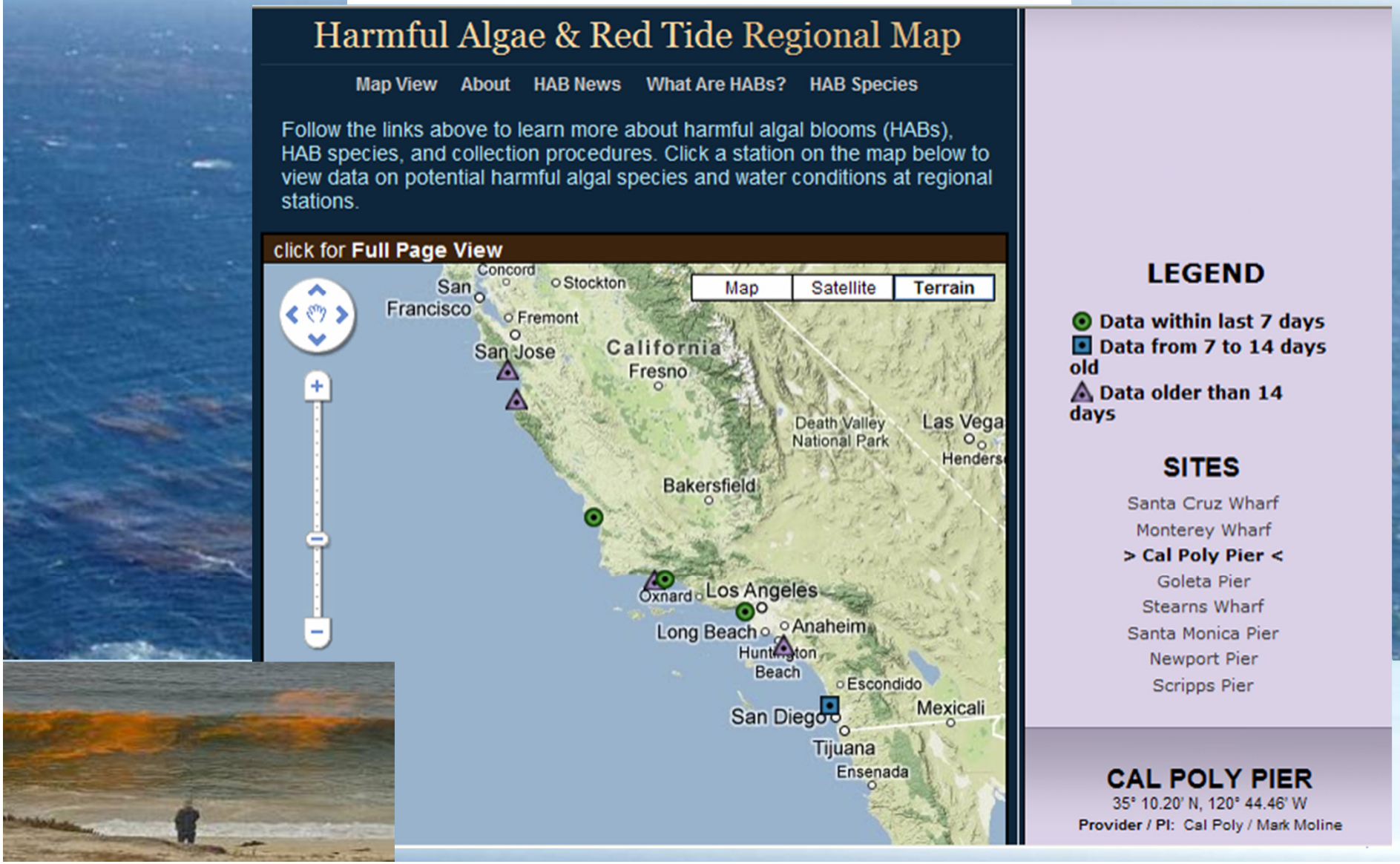
http://www.sccoos.org/data/piers



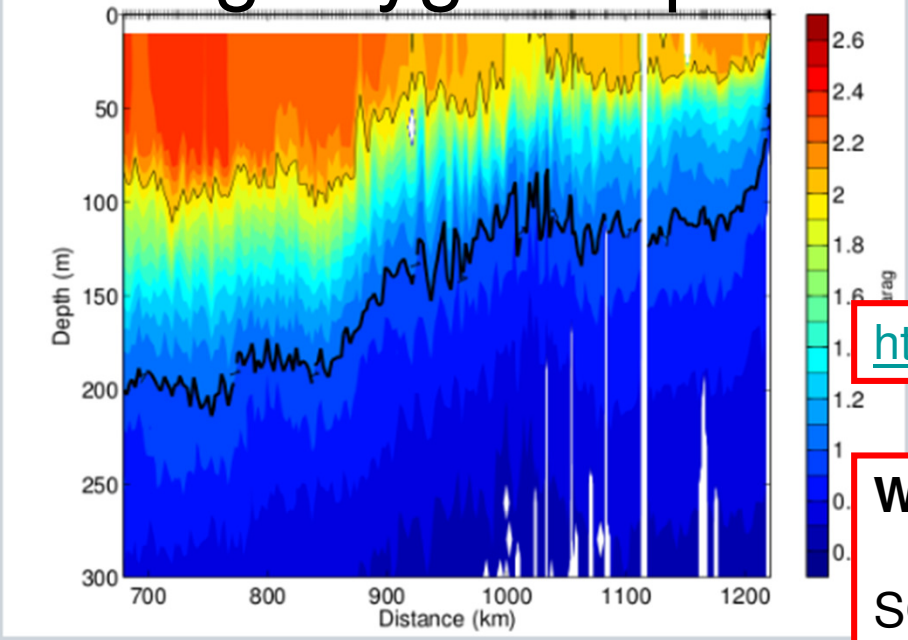


SCCOOS and CeNCOOS Support HAB detection which contributes to Cal HABMAP

http://www.sccoos.org/data/habs/index.php



SCCOOS support ocean acidification efforts by collecting oxygen & pH levels in coastal waters

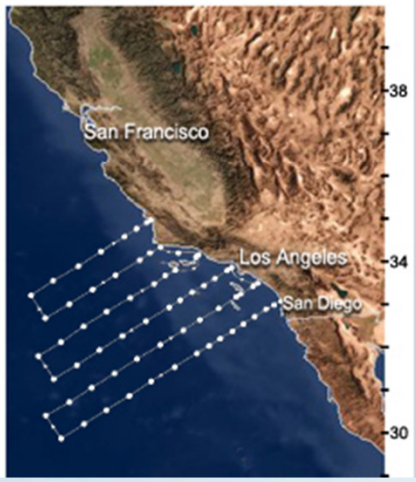


http://www.sccoos.org/projects/2012OA/

What is SCCOOS doing?

SCCOOS plans to add ocean acidification monitoring to its ongoing observations of the coastal ocean. Sensors that monitor pH, pCO_2, and dissolved oxygen can be added to pier stations and gliders. These observations will allow for continuous measurements of acidification in the Southern California Bight and will allow for improvements to be made to the models that forecast climate change.

CALCOFI



SCCOOS supports nine nearsho
stations of the California Cooper
Oceanic Fisheries Investigations
(CalCOFI). The CalCOFI group
collects samples to characterize
inorganic carbon system at selec
locations along its research cruis
tracks. Total inorganic carbon an
alkalinity are measured which all
for the calculation of pH and pC
http://calcofi.org/field-program
/rosette-sampling/454-under-co2

SWRCB Pilot Program on Ocean Acidification

- Durafet pH sensors have been installed at 3 CeNCOOS and 2 SCCOOS shore stations and 1 LOBO estuarine mooring
- Water samples are being collected weekly for analyses at Scripps
- Help establish pH variability in coastal ocean and determine best methods to measure it

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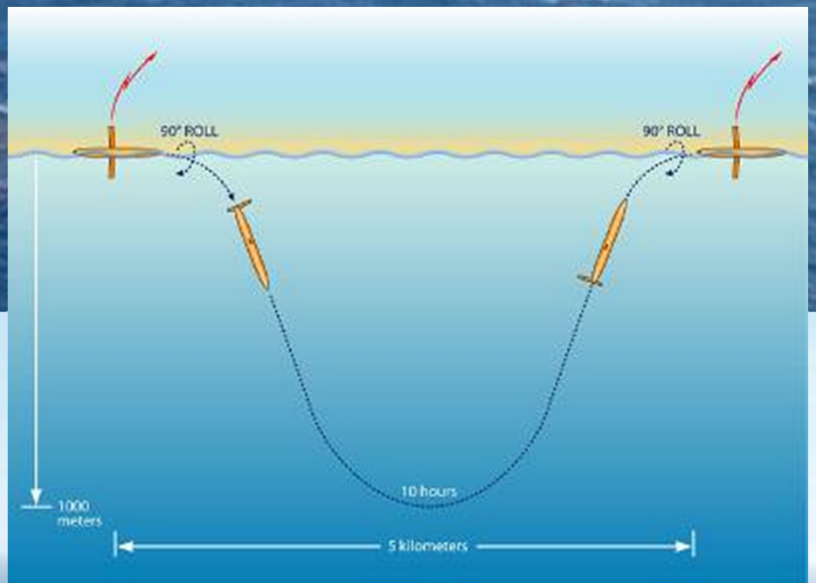
Southern California Coastal Ocean Observing System

Profiling Gliders

- Gliders are controlled remotely via satellite, and autonomously collect data in the water column along a transect
- Measure temperature, salinity, chlorophyll fluorescence, current velocity—and soon, dissolved oxygen (and pH and aragonite saturation via proxy relationships for **acidification monitoring**)
- Data is assimilated into numerical models, and used in studies of climate change and its impacts on California's coast



CeNCOOS

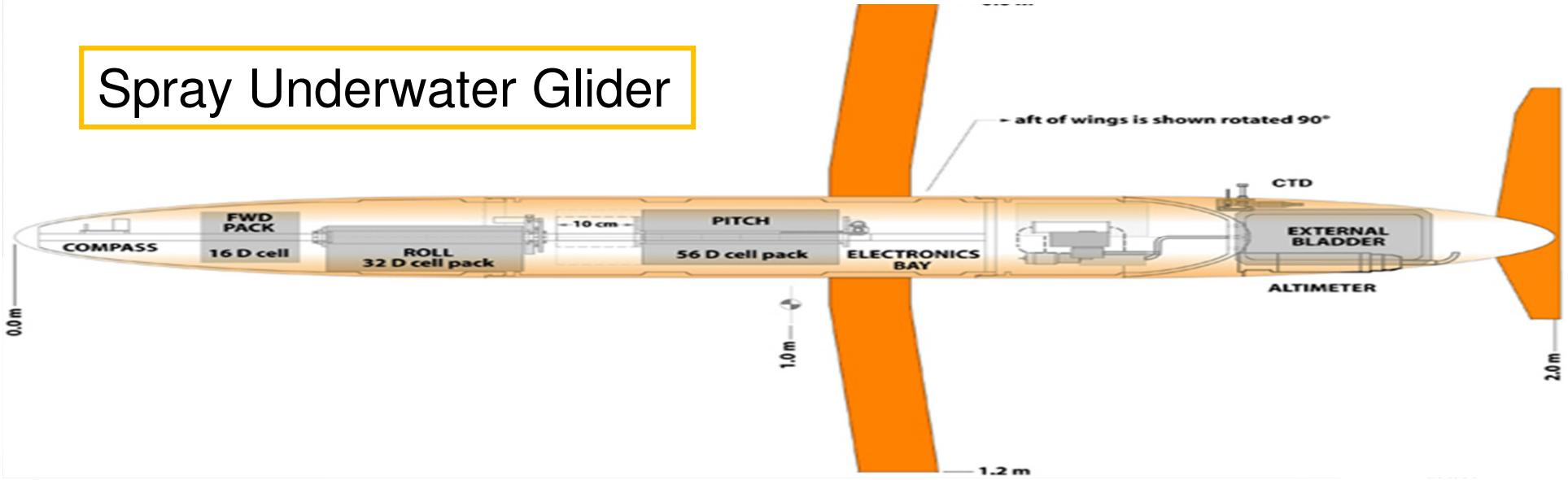
Southern California Coastal Ocean Observing System

How Gliders Work…

- Weight: 50 kg, Length: 2 m, wingspan: 1 m
- Profiles by changing buoyancy
- Steers by changing center of mass
- 2-way Iridium communication
- GPS navigation
- Pressure, temperature, salinity, velocity, chlorophyll, fluorescence, acoustic backscatter, nitrate, optical backscatter, ...

Glider operations on the US coast

Spray Underwater Glider

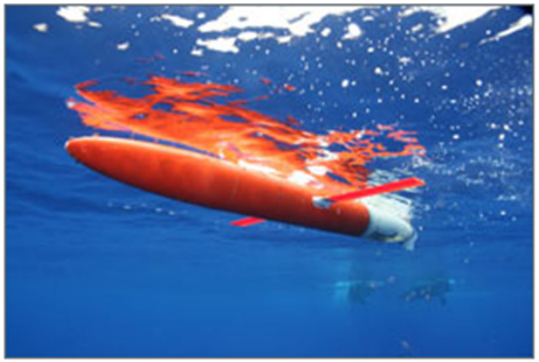


CeNCOOS Glider info

http://www.cencoos.org/sections/data/glider/

Ocean Glider Data

Spray gliders are operated collaboratively by MBARI, Scripps Institute of Oceanography and CeNCOOS with funding from NOAA and the State of California. Real-time data from the current glider mission is available as well as access to data from prior missions. Typically the gliders sample water temperature, salinity, chlorophyll flourescence and acoustic backscatter from the surface to 500 meters depth.



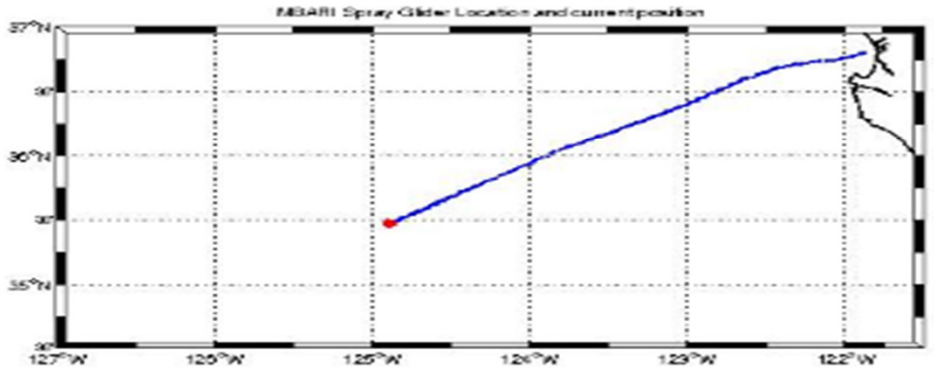
Current Glider Missions

Monterey Bay Offshore Glider (Transect 66/67)

Deployed from Apr 2012 to Present

- Current Mission Data and Plots
- Archived Data Access

Current Glider Position



Recent track (blue line) and current location (red dot)

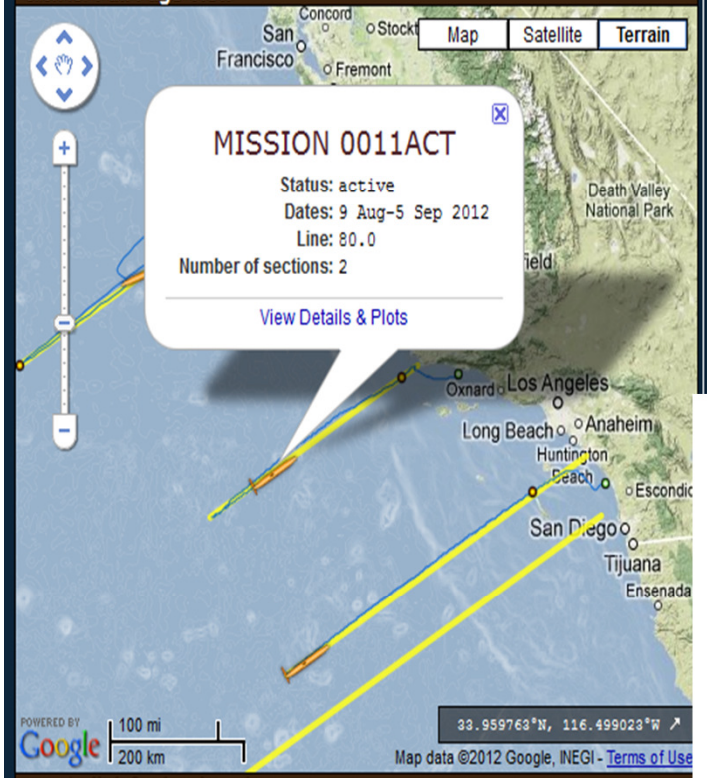
SCCOOS Glider info

http://www.sccoos.org/data/spray/?r=0

Spray Glider missions are shown on the map below. Click on a glider line to show missions on that line, choose which missions to display from the legend and map control, and view individual missions from the table below.

IOOS is developing a National Glider/Sub-Surface Plan. Attached is a preliminary whitepaper.

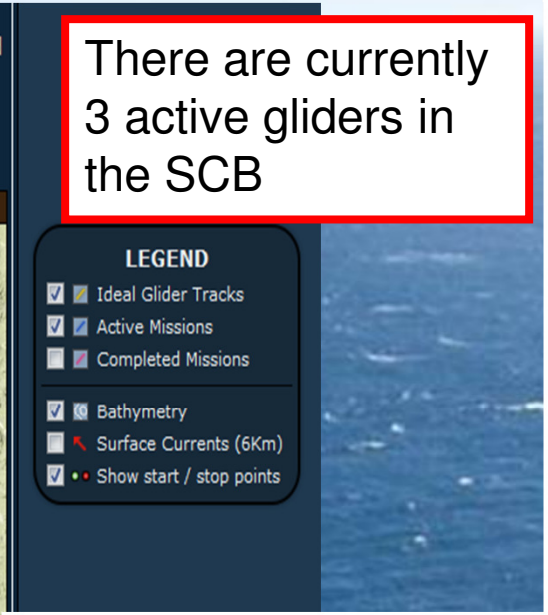
click for **Full Page View**



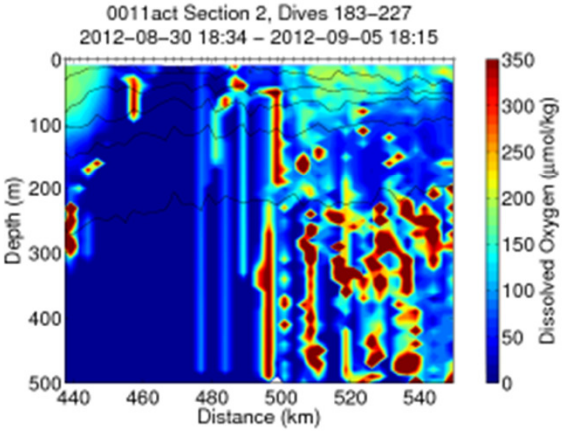
create link for bookmark

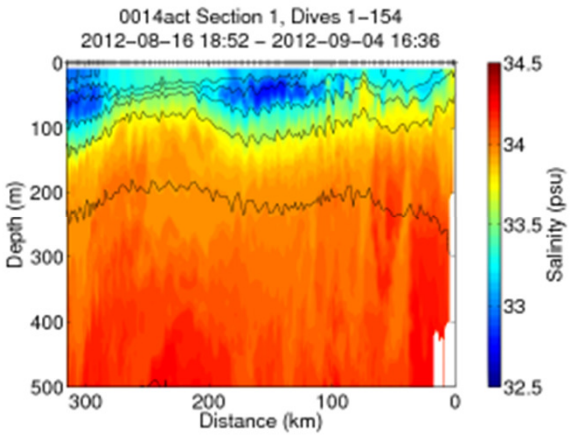
Active Missions

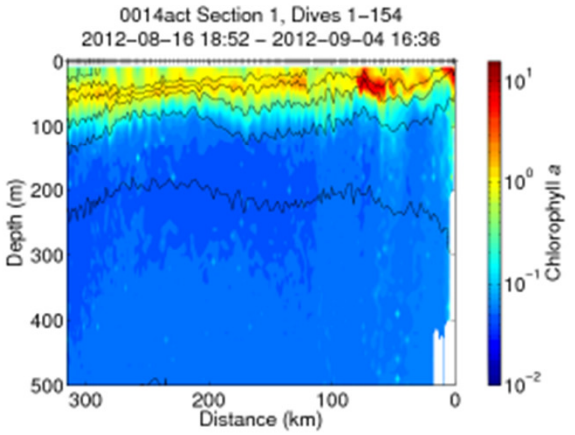
	Mission	Line	Begin	End
☑	0014act [details]	66.7	2012-08-16 18:15 UTC	2012-09-05 17:56 UTC
☑	0041act [details]	66.7	2012-04-24 17:07 UTC	2012-08-16 17:24 UTC
☑	0011act [details]	80.0	2012-08-09 18:52 UTC	2012-09-05 19:01 UTC

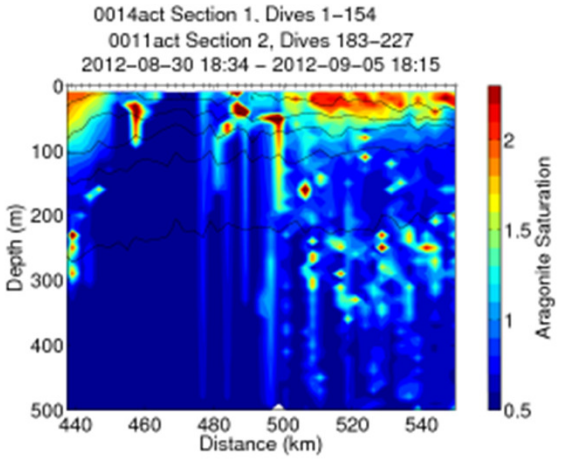


There are currently 3 active gliders in the SCB









Possible Future Capabilities

http://cencoos.org/sections/news/Pacific_glider_crossing.shtml

- Surface wave gliders

4 wave gliders were launched on Nov. 7, 2011 out of San Francisco. During their 33,000 nautical mile journey, they will travel across some of the world's most challenging environments.

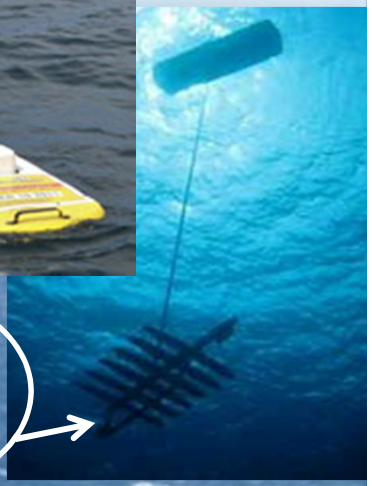


Photo from above and below

- Ambient noise and acoustic tag monitoring

Acoustic tags, small sound emitting devices, have been mounted on various pelagic fish. Receivers on moorings and wave gliders detect tagged fish that are within 400 - 800 m, and the information is relayed to shore via satellite. Other types of receivers detect ambient noise. Other types of animal tags measure oceanographic properties as well as animal's position.

BREAK!!

CeNCOOS

Meet Back in This Room in 15 Minutes, Thank you!

Southern California Coastal Ocean Observing System

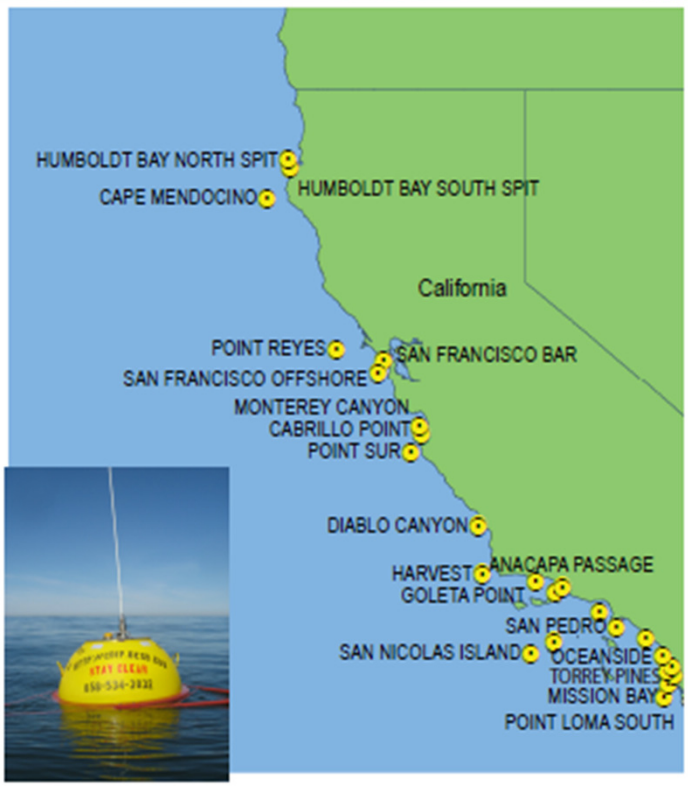
Coastal Data Information Program

Wave Buoys

Mission: Monitor and predict near shore waves and shoreline change.

- Based at SIO since 1975
- 35 Wave Stations
  LIDAR & In-Situ Beach Surveys
- 17 People
- $3.5M+ / year budget
- Funded by:
  USACE
  CDBW (SCCOOS
  NOAA, CCC,ONR…)

Investigators:
Richard Seymour
Robert Guza
Bill O'Reilly



CDIP wave buoys in California

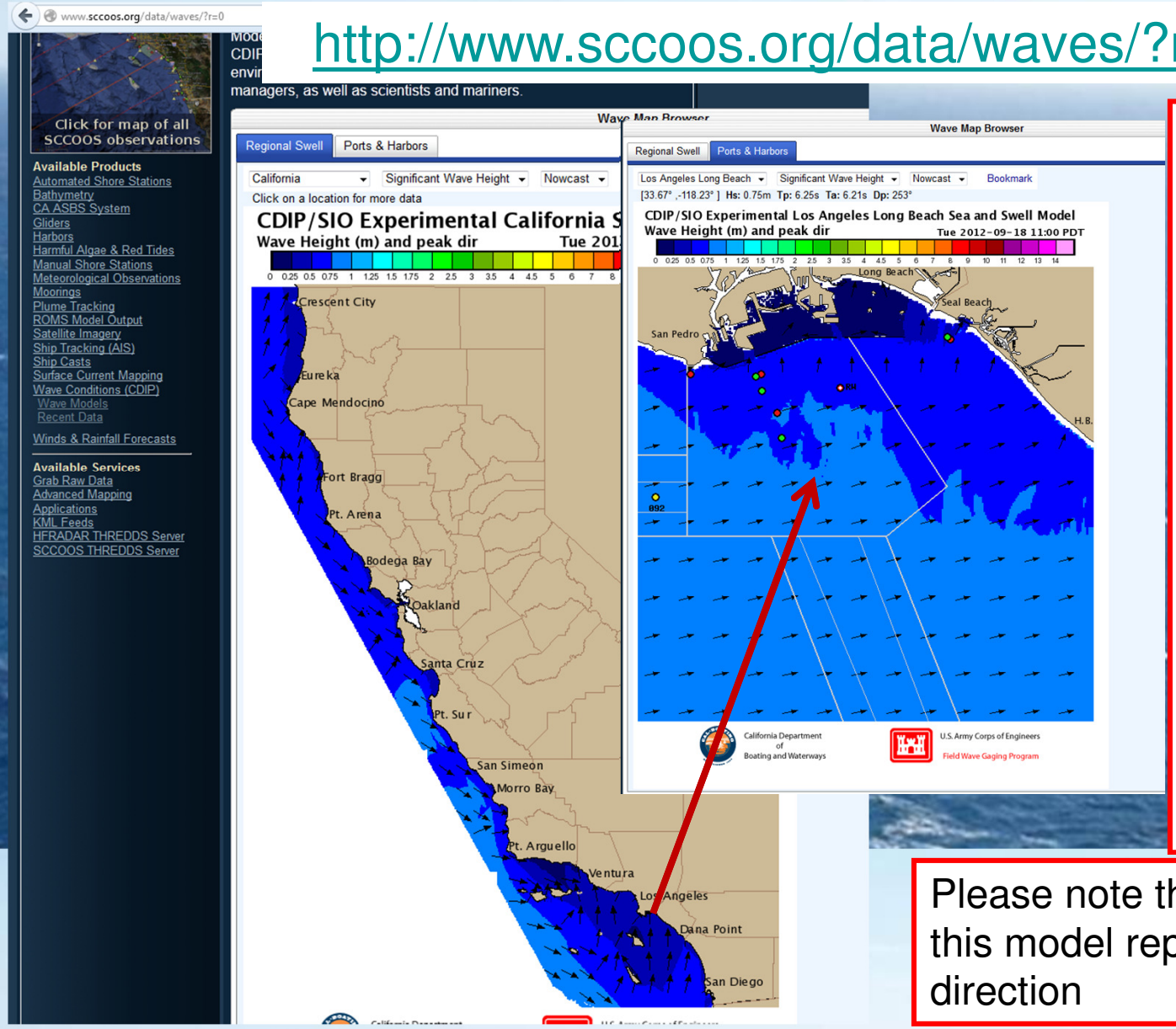
Storm and El Niño enhanced sea levels during an extreme tide

Ocean Beach Feb 1983

Current CDIP Measurements Contribute To Baseline & Sustaining Data

SCCOOS Swell Model

http://www.sccoos.org/data/waves/?r=0

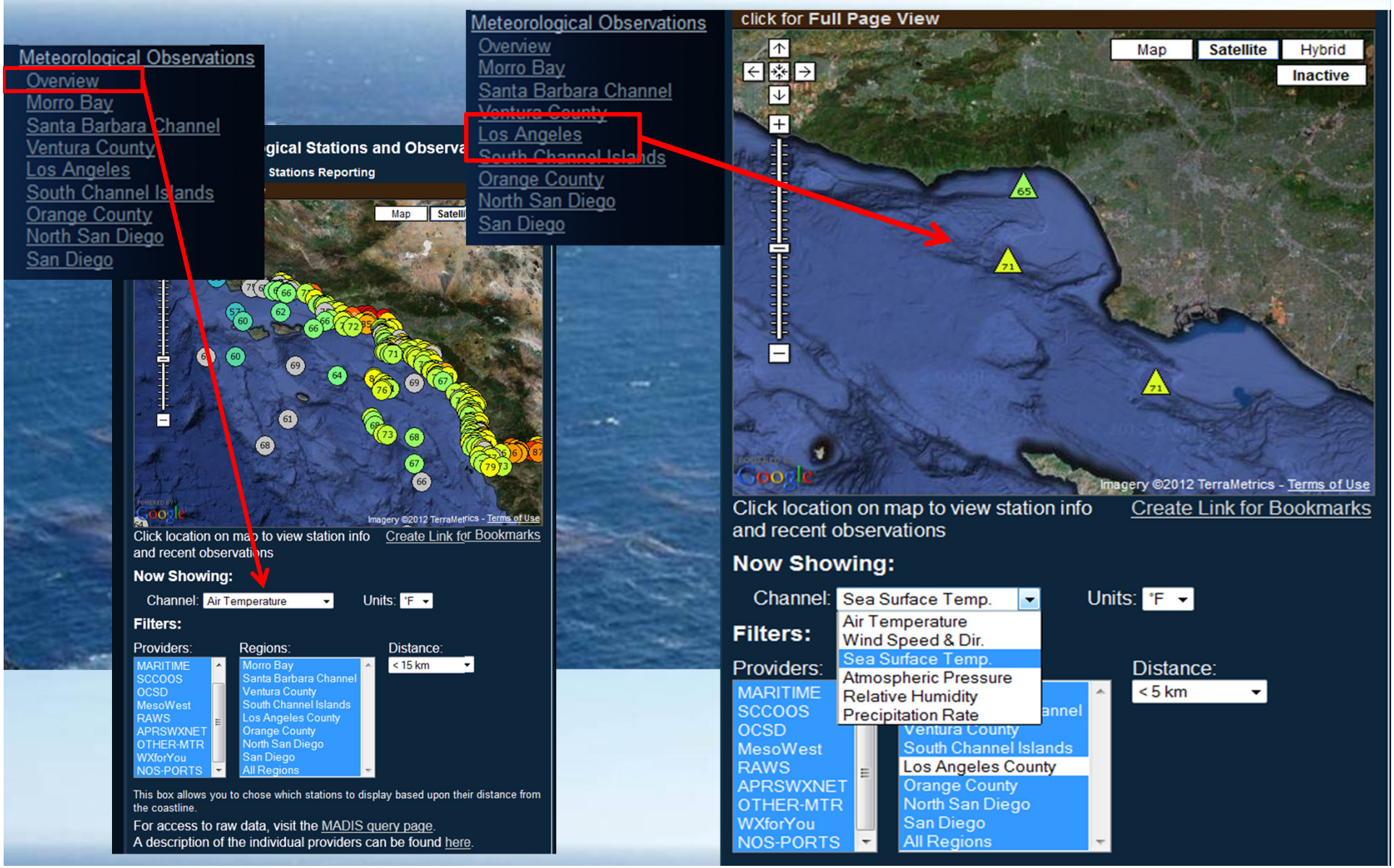


Models provided by The Coastal Data Information Program (CDIP). CDIP measures, analyzes, archives, and disseminates coastal environment data for use by coastal engineers, planners, and managers, as well as scientists and mariners.

Please note the arrows on this model represent swell direction

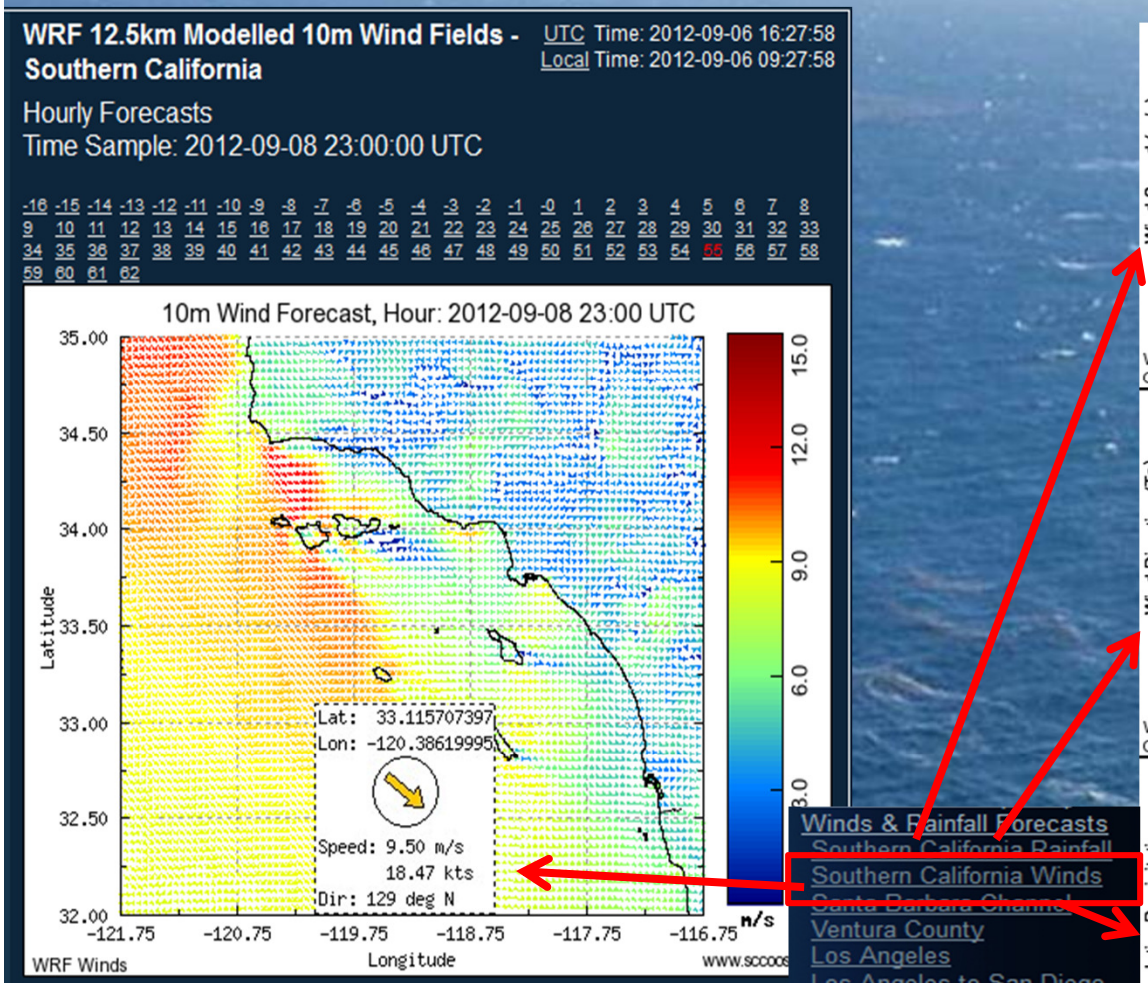
SCCOOS Meteorological Observations

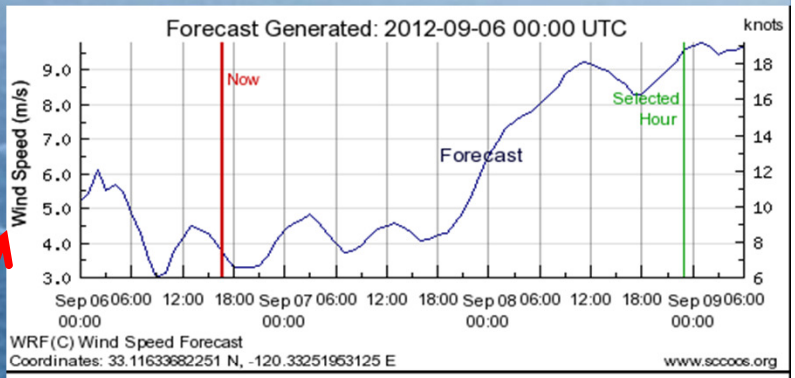
http://www.sccoos.org/data/mets/

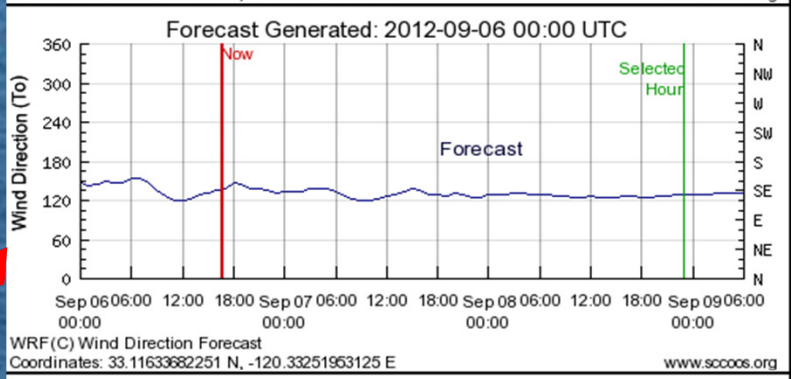


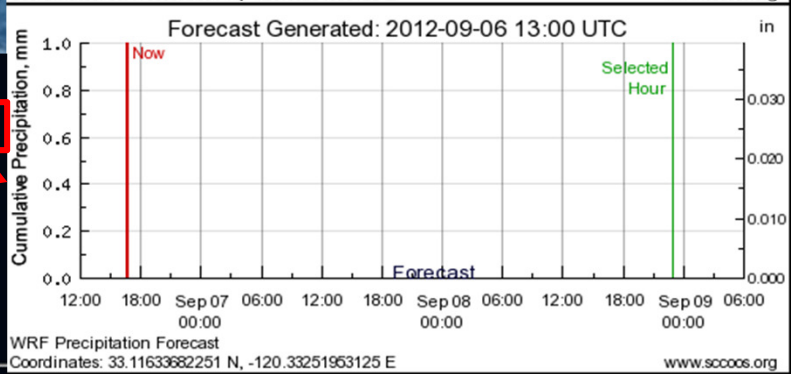
SCCOOS Weather Research & Forecasting 12.5 km Model

http://www.sccoos.org/data/winds/









Winds & Rainfall Forecasts
Southern California Rainfall
Southern California Winds
Santa Barbara Channel
Ventura County
Los Angeles
Los Angeles to San Diego
South Channel Islands
Orange County
North San Diego
San Diego

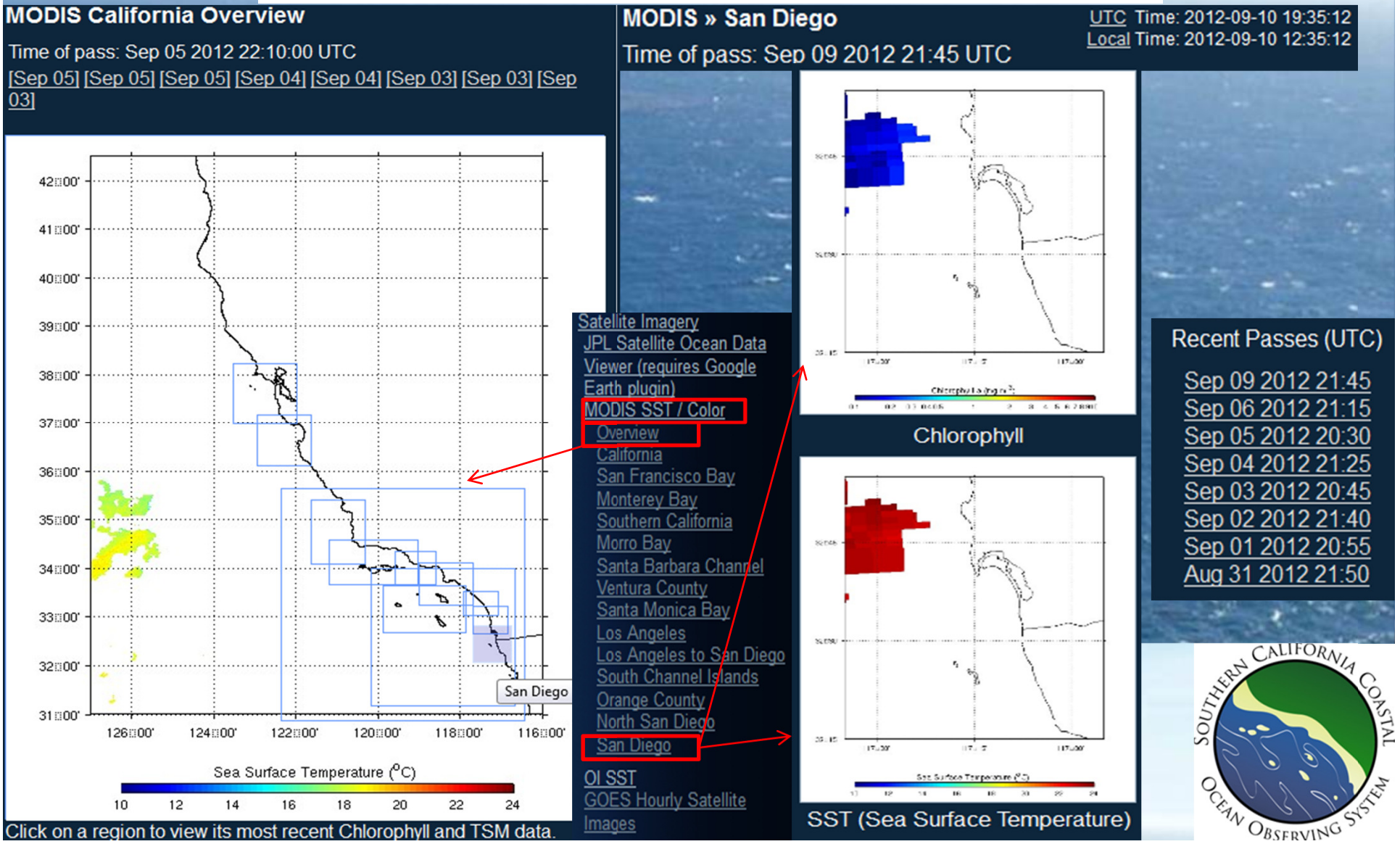
Credits:

Weather Research & Forecasting Model (WRF) wind and precipitatic forecasts are provided by UCLA Department of Atmospheric and Oceanic Sciences, Climate Sensitivity Research Lounge.

SCCOOS Remote Sensing

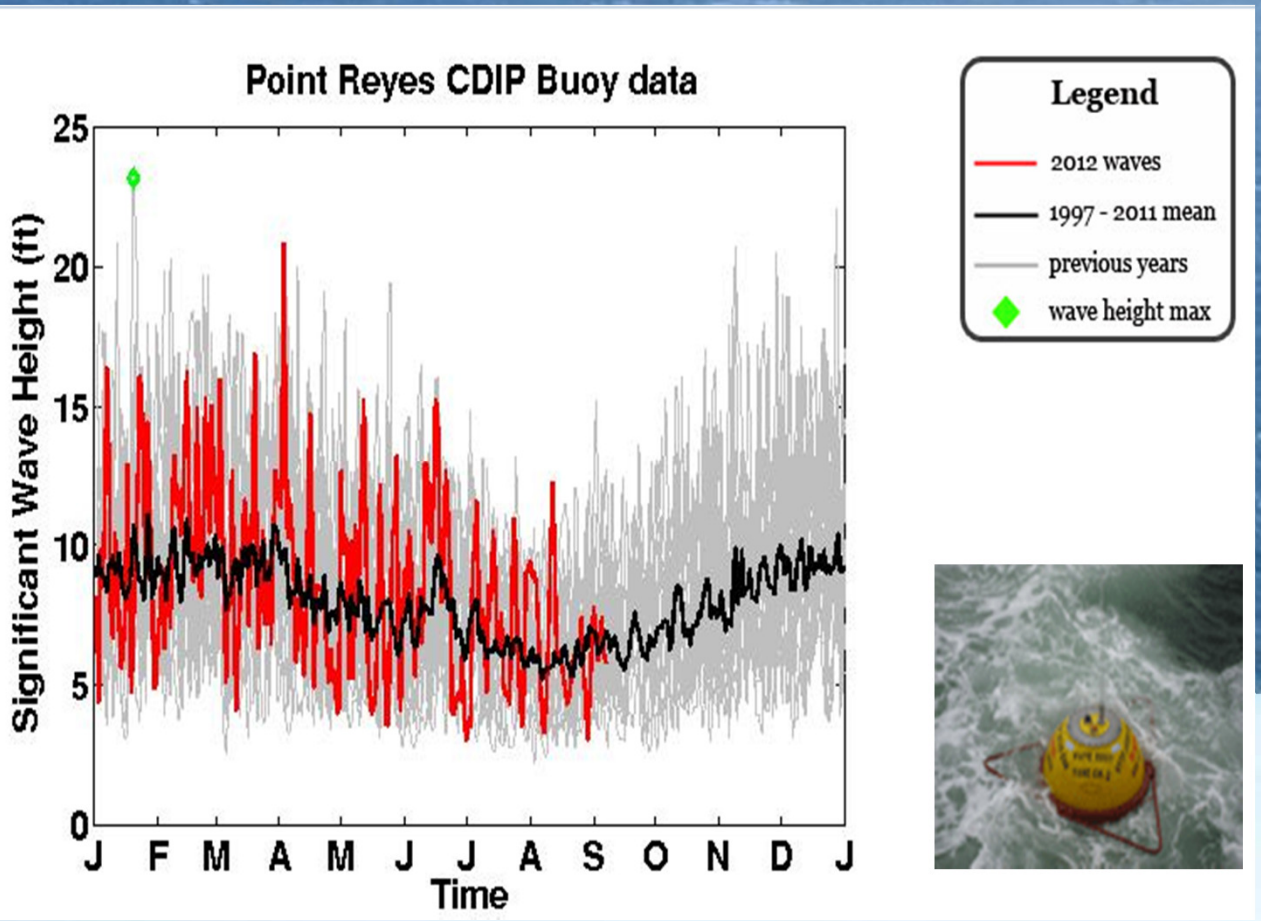
Sea Surface Temperature and Chlorophyll

http://www.sccoos.org/data/modis/modis_california.php



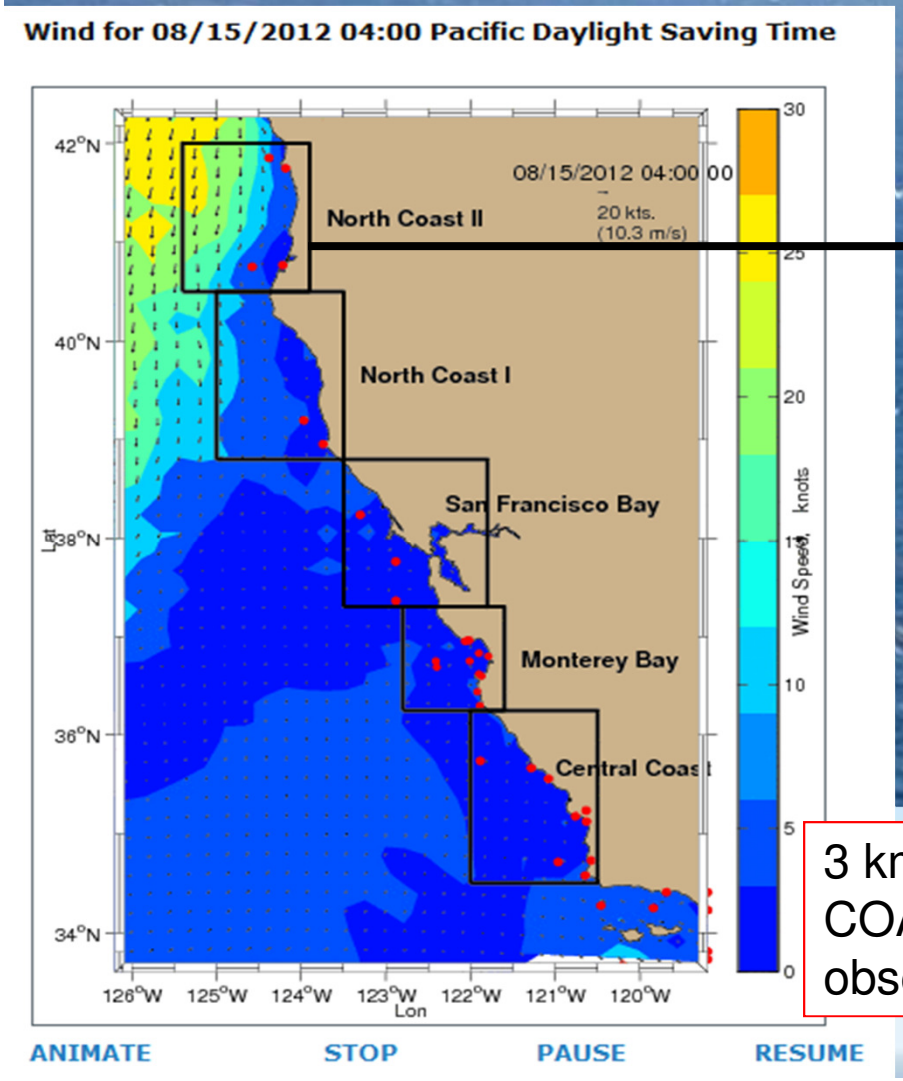
Wave Climatology: CDIP Buoy Pt. Reyes Past/Present Wave Heights

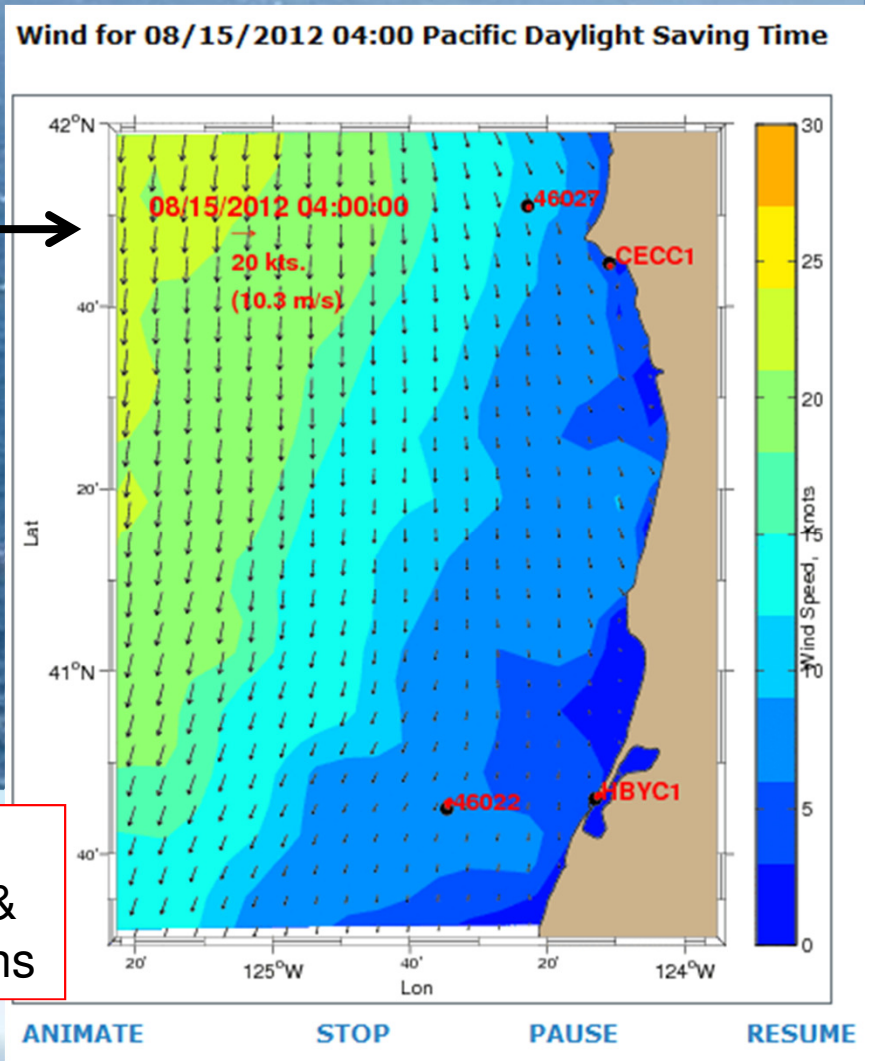
http://www.cencoos.org/sections/products/wave_climatology.shtml



CeNCOOS Coastal Winds Model and Observations

http://www.cencoos.org/sections/products/winds_product_descrip.shtml

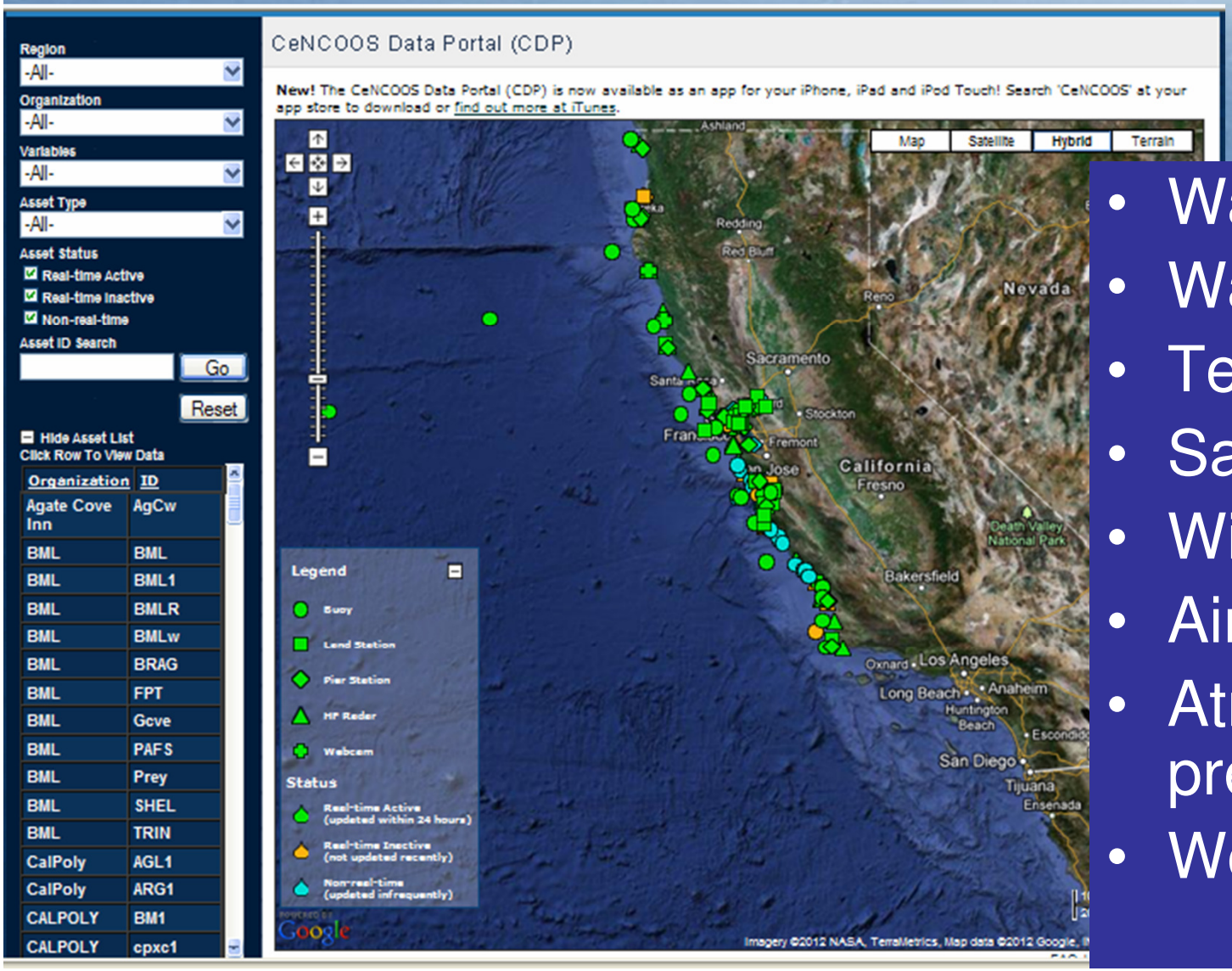




3 km COAMPS & observations

CeNCOOS Data Portal

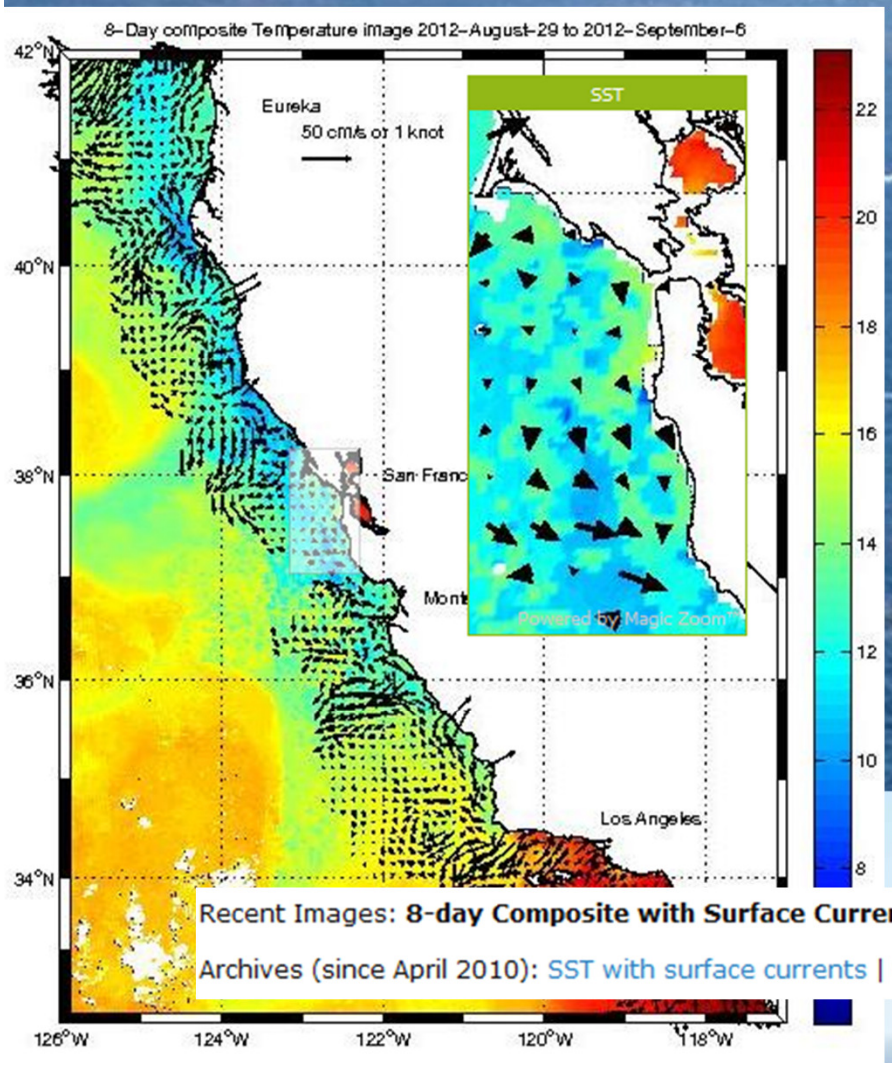
http://204.115.180.244/CeNCOOS/DataPortal.html

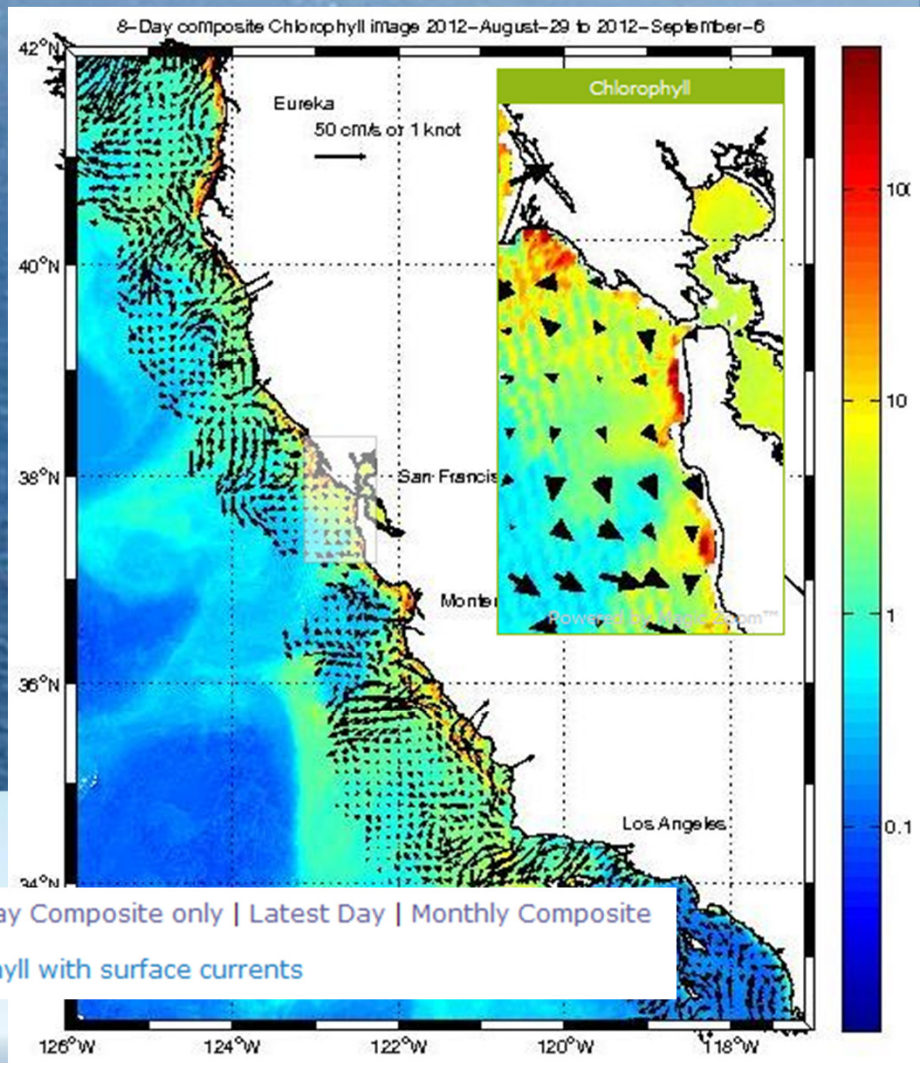


- Waves
- Water level
- Temperature
- Salinity
- Wind
- Air temperature
- Atmospheric pressure
- Web cams

CeNCOOS Remote Sensing
Sea Surface Temperate (SST) & Chlorophyll

http://www.cencoos.org/sections/conditions/SST_Chl.shtml

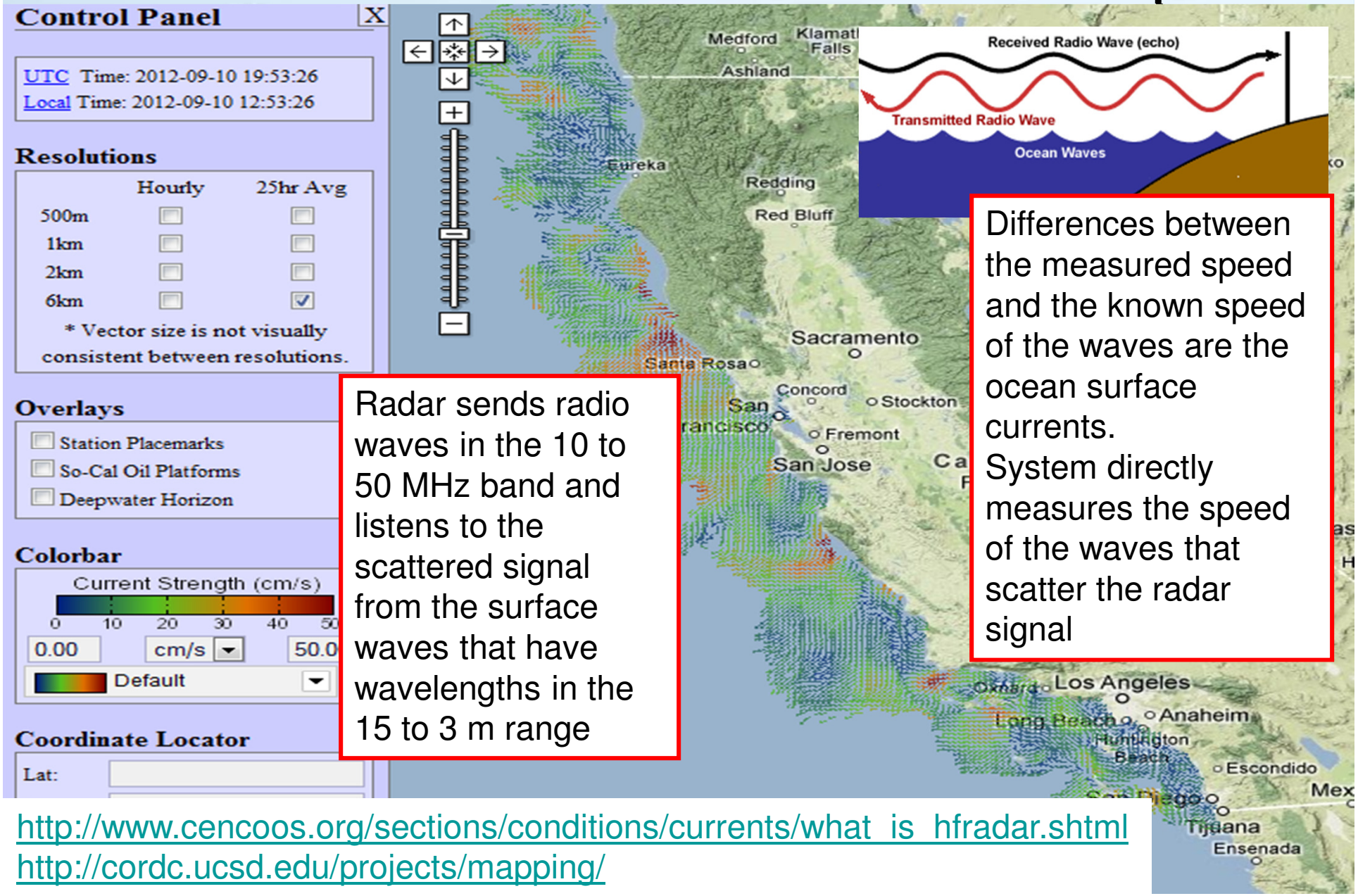




Recent Images: **8-day Composite with Surface Currents** | 8-day Composite only | Latest Day | Monthly Composite

Archives (since April 2010): SST with surface currents | Chlorophyll with surface currents

HF Radar Surface Current Maps



Radar sends radio waves in the 10 to 50 MHz band and listens to the scattered signal from the surface waves that have wavelengths in the 15 to 3 m range

Differences between the measured speed and the known speed of the waves are the ocean surface currents.
System directly measures the speed of the waves that scatter the radar signal

http://www.cencoos.org/sections/conditions/currents/what_is_hfradar.shtml
http://cordc.ucsd.edu/projects/mapping/

Real Time Processing of HF Radar-Derived Surface Current Mapping Data

- Retrieve radial current fields from each site each hour
- Form vector maps
- Fill spatial gaps
- Compute surface particle trajectories
- Estimate tomorrow's velocity fields based on recent mean current and tidal fluctuations
- Produce netCDF file for GNOME model with 48 hr observations and 24 hr forecast

CeNCOOS

COCMP
Coastal Ocean Currents Monitoring Program

Southern California Coastal Ocean Observing System

Why is surface current mapping with high frequency radar (HFR) important?

Provides continuous, high resolution mapping of currents for:

- Tracking point source pollution or discharges
- Oil spill preparedness and response
- Search and Rescue
- Marine operations
- Connectivity analyses: e.g. MPAs, coastal discharges, larval retention areas
- Assimilation into numerical models
- Analysis of long-term trends

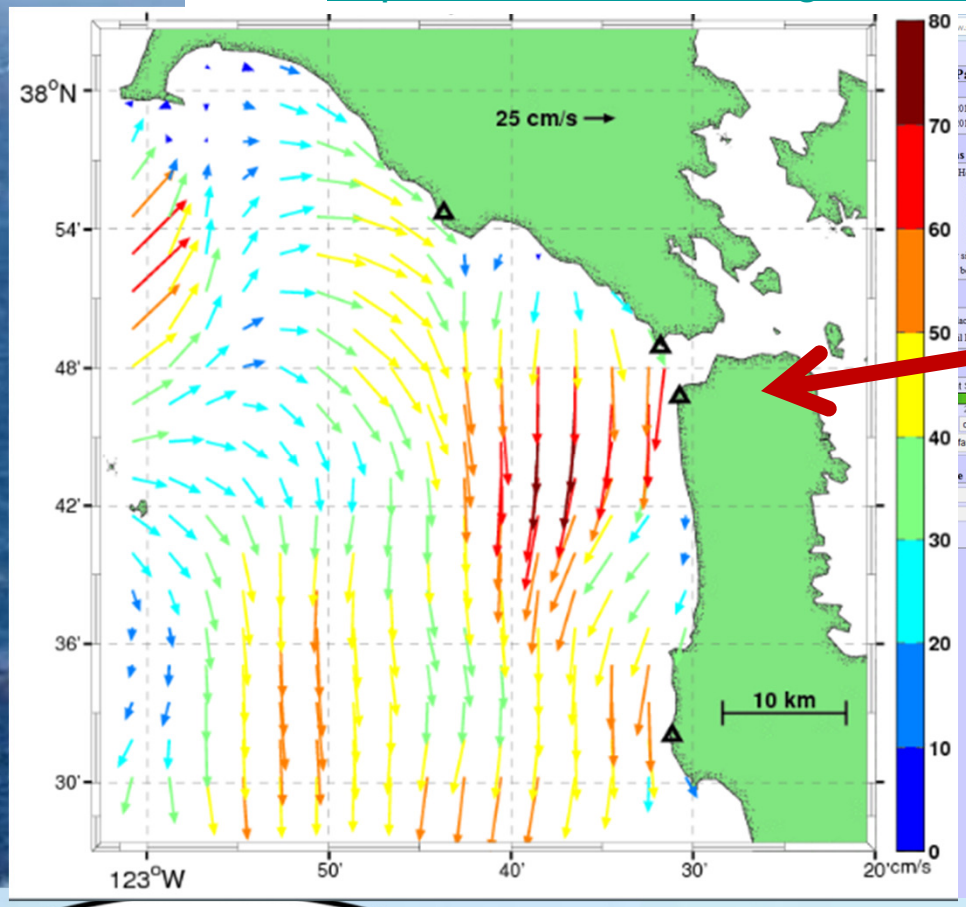
CeNCOOS

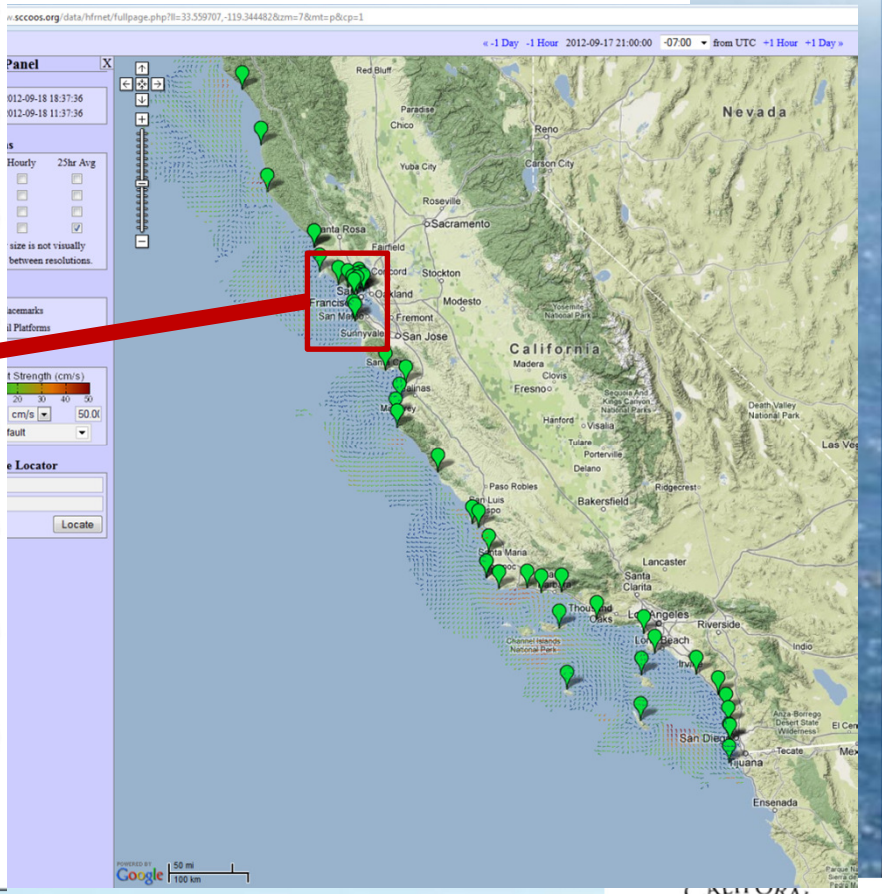
Sept. 24, 2012

Southern California Coastal Ocean Observing System

Ocean Surface Current Mapping with High-Frequency Radar

http://www.cencoos.org/sections/conditions/Google_currents/





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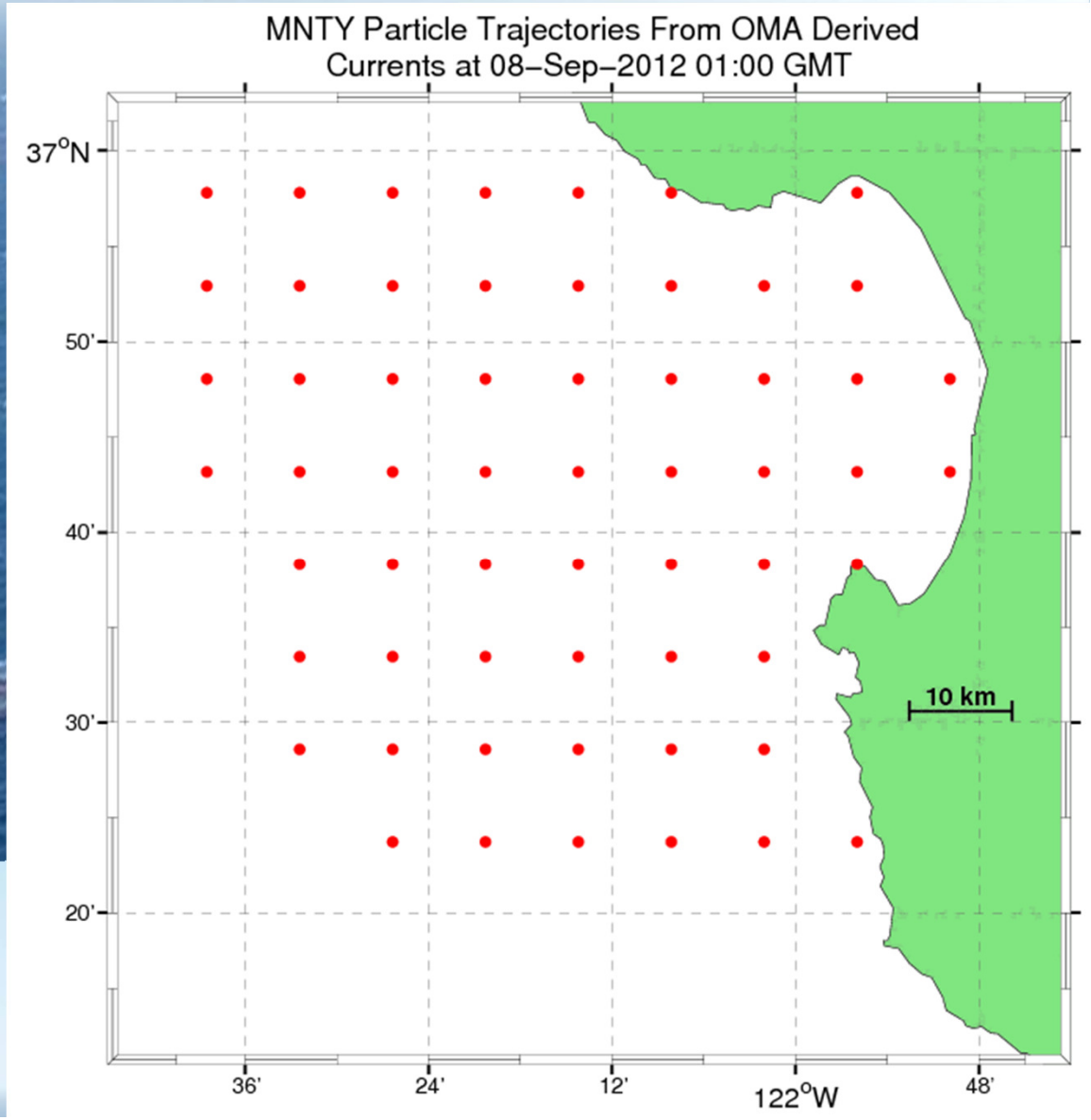
Southern California Coastal Ocean Observing System

A variety of hindcast, forecast, and daily average current products, and archived data, are available from CeNCOOS surface currents page: http://www.cencoos.org/sections/conditions/currents/index.shtml

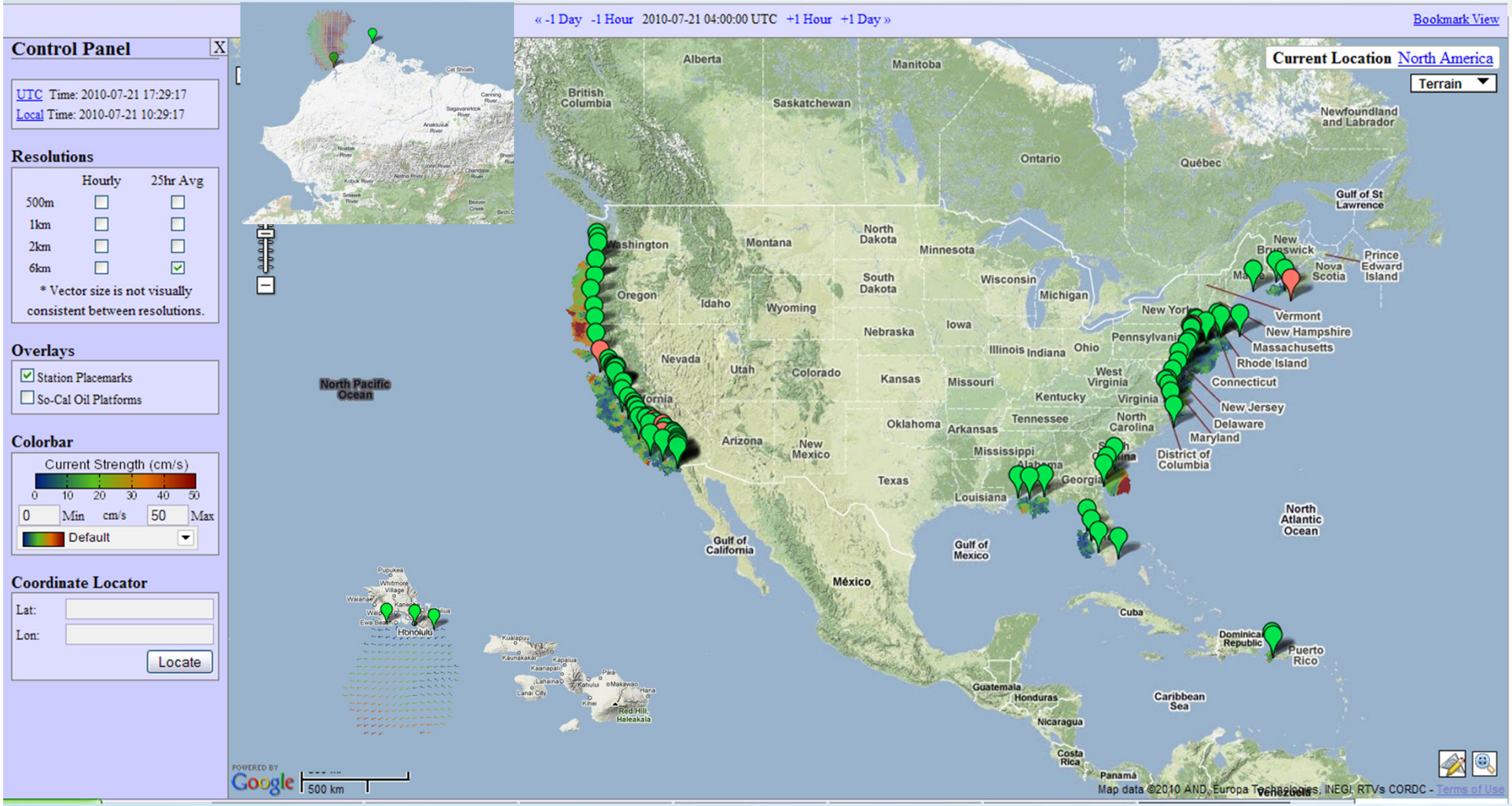
and from CeNCOOS HF radar current operator pages:
http://www.cencalcurrents.org/

http://www.norcalcurrents.org/COCMP/index.html

http://bml.ucdavis.edu/boon/currents.html



http://www.sccoos.org/data/hfrnet/



Numerical Ocean Models

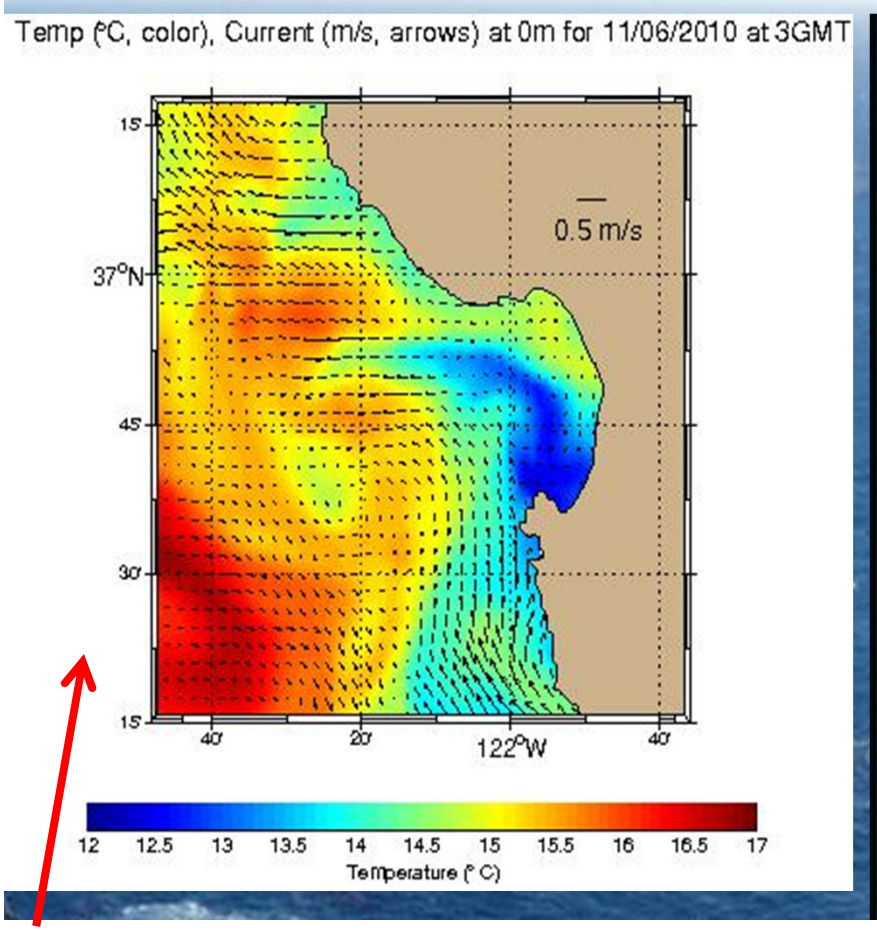
- 1-2 km resolution models in Monterey Bay and Southern CA Bight
- 3 km resolution model covering ocean off all of California
- 12 km resolution model running for area off whole West Coast
- Drop-a-drifter tool
- Virtual moorings
- Coupled physical-ecosystem models under development

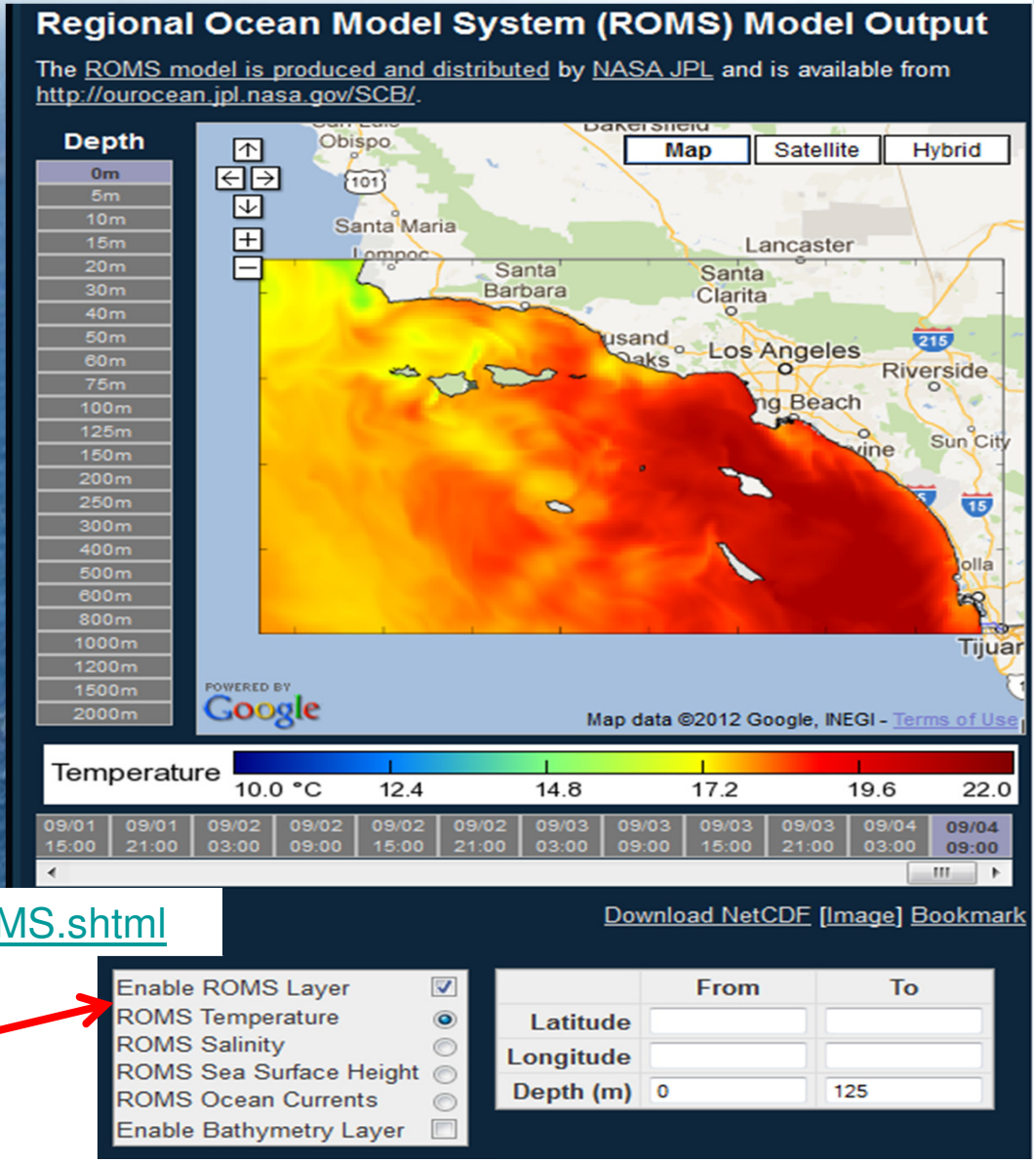
CeNCOOS

Sept. 24, 2012

Southern California Coastal Ocean Observing System

1-2 km resolution models in Monterey Bay and Southern CA Bight



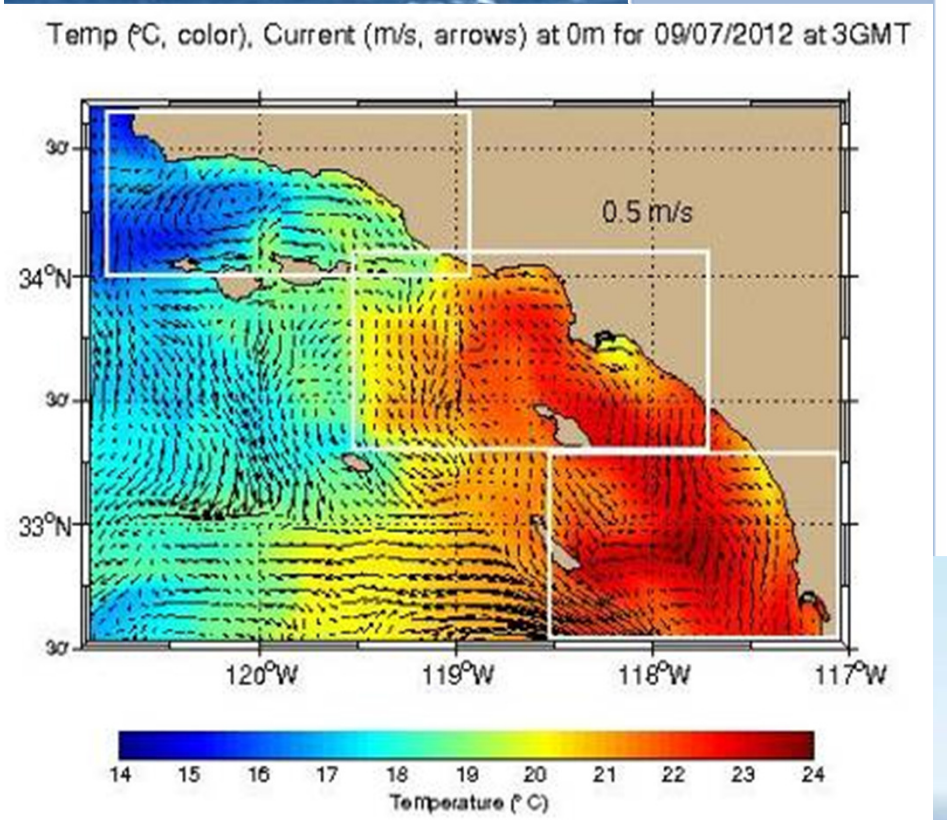


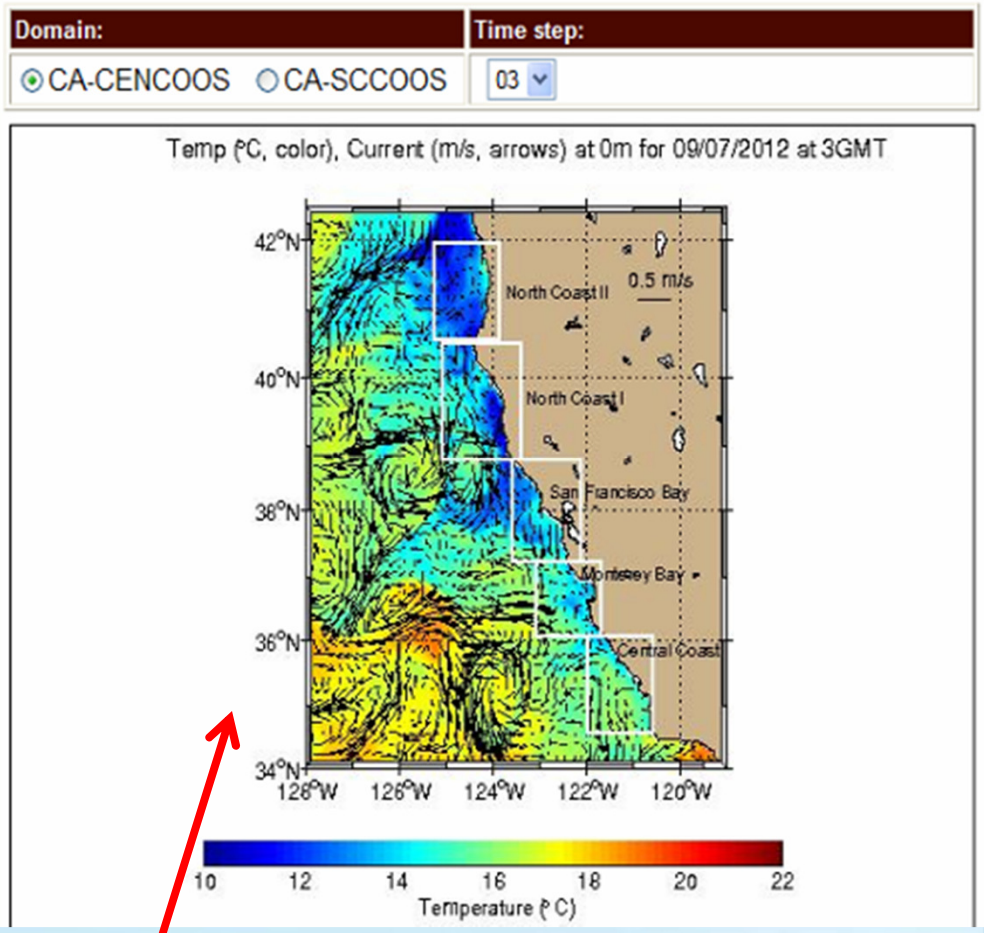
http://www.cencoos.org/sections/models/ROMS.shtml

http://www.sccoos.org/data/roms/

3 km resolution model covering ocean off all of CA

http://ourocean.jpl.nasa.gov/CA/

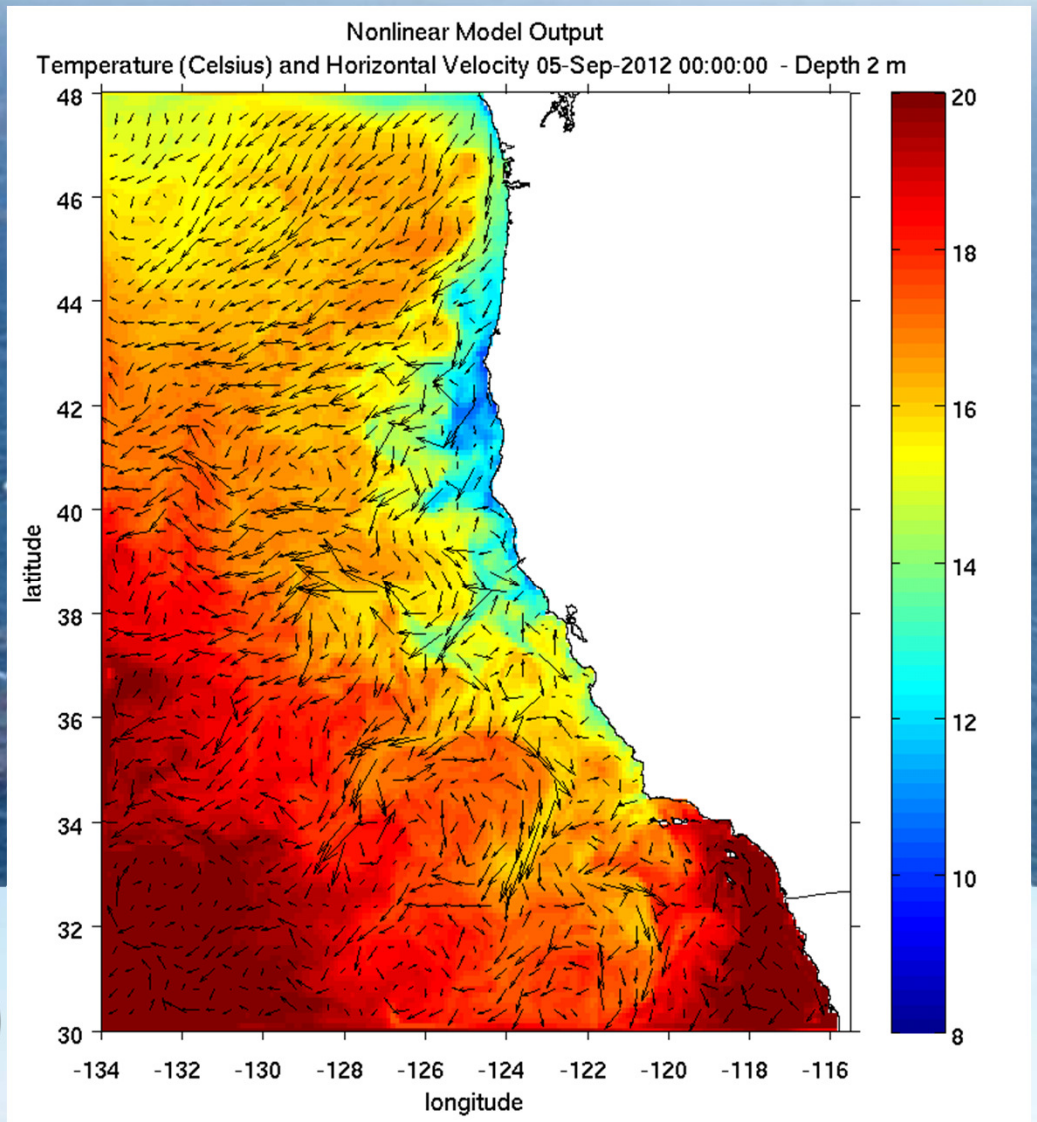




ROMS Nowcast - Temperature

12 km resolution model for whole West Coast

http://www.cencoos.org/sections/models/UCSC_ROMS.shtml

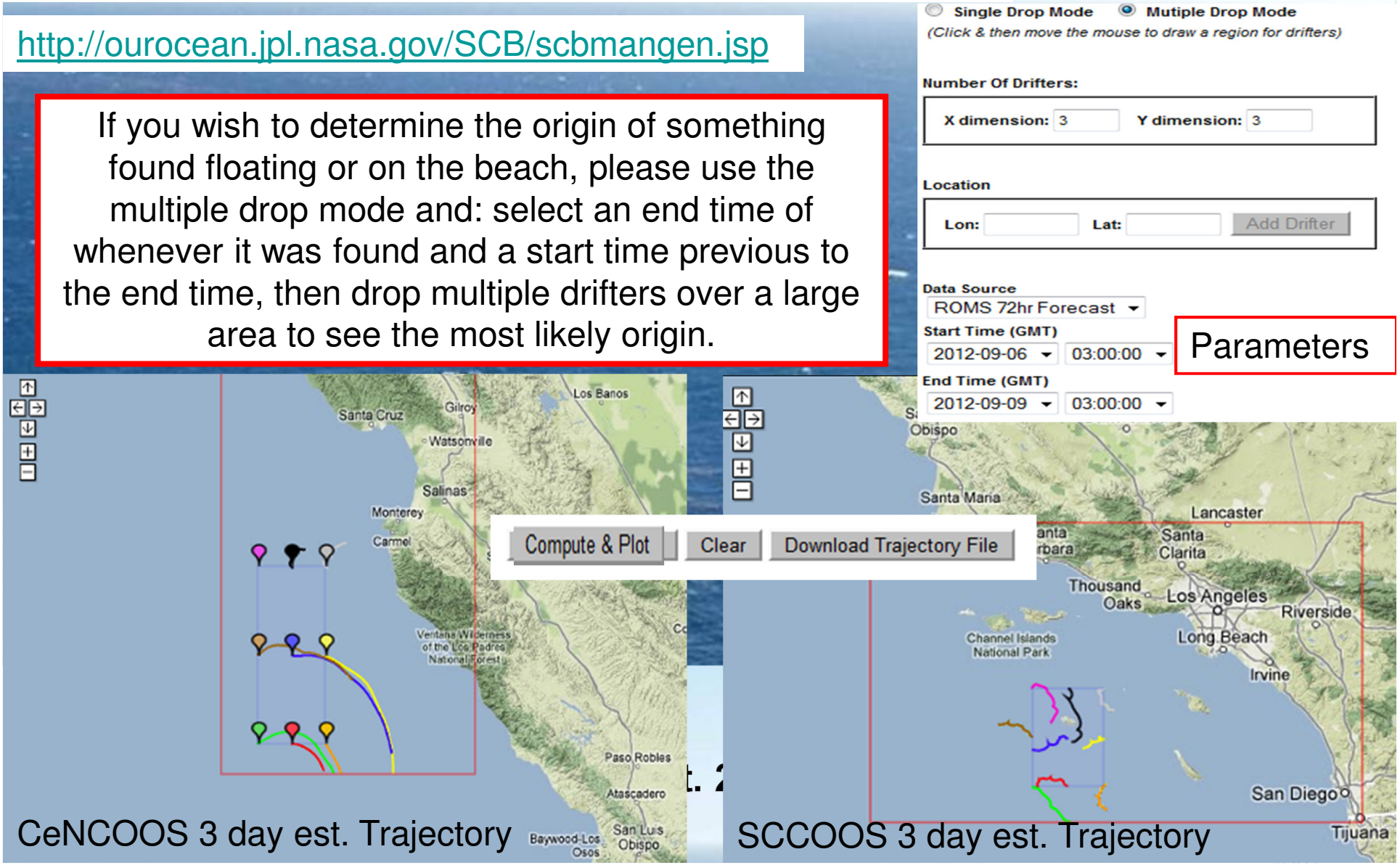


"Drop-a-Drifter" Surface Water Trajectories

http://www.cencoos.org/sections/products/drop_a_drifter.shtml

http://ourocean.jpl.nasa.gov/SCB/scbmangen.jsp

If you wish to determine the origin of something found floating or on the beach, please use the multiple drop mode and: select an end time of whenever it was found and a start time previous to the end time, then drop multiple drifters over a large area to see the most likely origin.



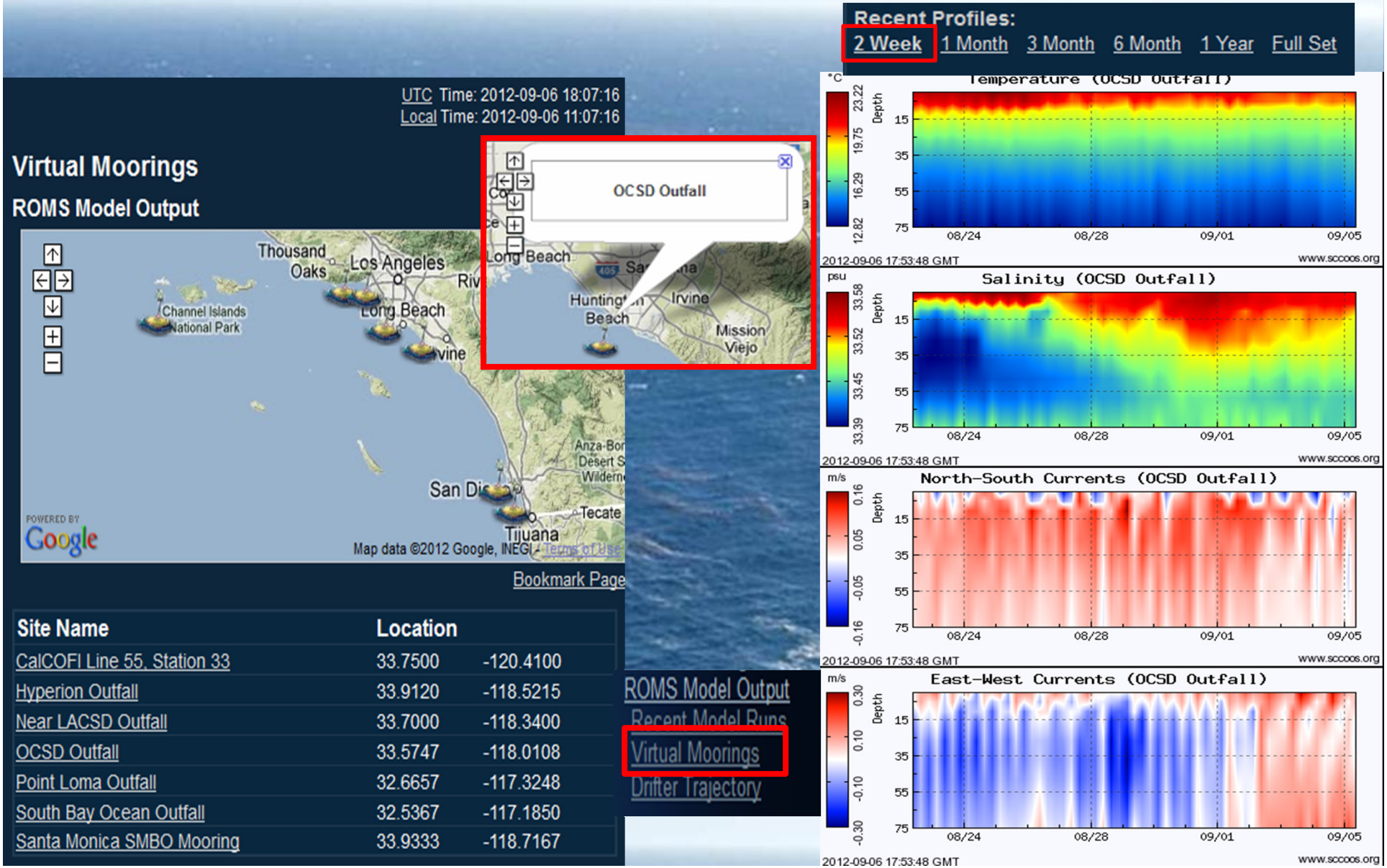
Parameters

CeNCOOS 3 day est. Trajectory

SCCOOS 3 day est. Trajectory

SCCOOS Virtual Moorings

http://www.sccoos.org/data/roms/virtual/



Site Name	Location	
CalCOFI Line 55, Station 33	33.7500	-120.4100
Hyperion Outfall	33.9120	-118.5215
Near LACSD Outfall	33.7000	-118.3400
OCSD Outfall	33.5747	-118.0108
Point Loma Outfall	32.6657	-117.3248
South Bay Ocean Outfall	32.5367	-117.1850
Santa Monica SMBO Mooring	33.9333	-118.7167

Biological and geochemical forecast models under development or consideration

- Statistical models relating ocean conditions to HABs
- Linked hydrologic, ocean, atmosphere models to forecast salmon populations
- Coupled physical/NPZD (nitrogen, phytoplankton, zooplankton, detritus) models for ecosystem forecasts
- Geochemical modeling to identify natural and outfall-based sources of nutrients

CeNCOOS

Sept. 24, 2012

Southern California Coastal Ocean Observing System

Lunch…Yum!

Meet Back in This Room in 1 Hour, Thank you!